The identification of nature and natural history of alcohol related frequent attenders to hospital

Blackwood, Ros

Awarding institution:
King's College London

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Rosalind Blackwood

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Abstract

In the UK, alcohol use costs the NHS £3.5 billion annually, with 80% spent on hospital based care. Alcohol related hospital admissions have more than doubled since 2003/04 to over a million admissions in England in 2015/16. A significant proportion of people who attend hospital for an alcohol related reason attend many times during a year and are known as “alcohol related frequent attenders” (ARFAs). With no universal way of identifying ARFA hospital admissions the true burden on the NHS is unknown including use of A&E services, costs of inpatient admissions and long-term health and social care. In addition, little is known about predictors of alcohol-related frequent attending.

My thesis presents the findings of studies investigating the nature and natural history of alcohol-related frequent attenders to hospital (ARFAs). ARFAs are defined as patients with a wholly-attributable alcohol-related diagnosis, and multiple hospital admissions during a 1 year period. The thesis includes a systematic review of the literature, presenting what is already known about the nature and characteristics of alcohol-related frequent attenders to hospital; along with new studies comprising a cross-sectional analysis of the characteristics of ARFAs, including in-depth analysis of co-morbid diagnoses; national longitudinal study of health service use by ARFAs and their outcomes; a longitudinal national study looking at the predictors of transition to ARFA; and estimates of the costs associated with ARFAs nationally to the NHS.

All of the studies include samples of patients drawn from national Hospital Episodes Statistics (HES) 2011/12-2015/16. From pseudonymised inpatient hospital records, data on natural history of ARFAs including: incidence, comorbidities (ICD 10 code), mode of admission, length of stay, readmissions, age, gender and geography are compared to 3 other groups of patients from 2011/12- 2015/16 national HES: non-alcohol-related-frequent attenders, non-alcohol-non-frequent attenders and alcohol-related-non-frequent attenders. Longitudinal analysis of the 2011/12 ARFA cohort followed through to 2015/16,

yields information on service use patterns once someone is identified as being an ARFA, existing and developing co-morbidities, and outcomes such as readmissions and health status. In contrast, longitudinal analysis of a cohort of new ARFAs (no previous history of being an ARFA) yields information on service use patterns and other predictors of outcomes. Using findings from the longitudinal analyses, costs of health service usage by ARFAs is modelled using national tariffs and occupied beddays.

These novel studies measuring the scale of alcohol-related frequent hospital admissions in England over a 5-year period and associated burden identify a typical ARFA as being male, aged approximately 55 years, living in a more deprived area, with multiple physical and mental health comorbidities including a chronic alcohol diagnosis. ARFAs are more complex than other patient groups and alcohol is a key factor in causing inpatient admissions (often the primary diagnosis) rather than being an incidental finding.

ARFAs' medical history is chronic in nature and 10% of ARFAs are frequently admitted to hospital every year for 5 years. ARFAs have poor health outcomes: with higher prevalence rates of alcohol related liver disease compared to other patient groups. ARFAs have a lower probability of survival at 5 years than other patient groups. Nationally, ARFAs are significant enough in number to place a substantial burden on the NHS: an average ARFA occupies 10 extra bed days per year compared to a non-alcohol frequent attender and this is because ARFAs have longer lengths of stay compared to other groups.

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Glossary of abbreviations

AAF	Alcohol attributable fraction
A&E	Accident and emergency department
AOT	Assertive outreach treatment
ARFA	Alcohol related frequent attender
ARLD	Alcohol related liver disease
ARNFA	Alcohol related non frequent attender
CI	Confidence interval
CIPS	Continuous Inpatient Spell
CMO	Chief Medical Officer
DARS	Data access request service
DH	Department of Health
ED	Emergency department
FCE	Finished consultant episode
HED	Heavy episodic drinking
HES	Hospital episode statistics
HESID	Hospital episode statistics patient identification
HR	Hazard ratio
HRG	Healthcare resource group
HSCIC	Health and Social Care Information Centre
IARC	International Agency for Research on Cancer
ICD 10	International classification of diseases, version 10
IMD	Indices of Multiple Deprivation
LSOA	Lower super output area
MAO	Monoamine oxidase
NAFA	Non alcohol frequent attender
NANFA	Non alcohol non frequent attender
NCHOD	National Centre for Health Outcomes Database
NICE	National Institute for Health and Care Excellence
OBD	Occupied bed day
OECD	Organisation for Economic Cooperation and Development
ONS	Office for National Statistics
OR	Odds ratio
PAAD	Partially attributable alcohol diagnosis
PTSD	Post traumatic stress disorder
PHE	Public Health England
PICOS	Population, Intervention, Comparator, Outcome, Study type
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
RR	Relative risk
SES	Socioeconomic status
WHO	World Health Organisation
WAAD	Wholly attributable alcohol diagnosis

1 Introduction

1.1 Background

Globally, alcohol has a considerable impact on health, social and economic outcomes. Worldwide, excess alcohol consumption results in approximately 3.3 million deaths every year (5.9% of all deaths) and 5.1% of the total global disease burden is related to alcohol consumption (WHO, 2014). In the UK, alcohol misuse is a major public health challenge: it is the leading cause of preventable disability in working age men (Rehm et al, 2009; Shield et al, 2012) and the third greatest risk factor for years lived with disability (Lim et al, 2012). Levels of alcohol consumption in the UK are above the Organisation for Economic Co-operation and Development (OECD) average and and the UK has one of the highest prevalences of heavy episodic drinking in the world (WHO, 2014).

In the UK, deaths from liver disease are now a leading cause of premature death (WHO, 2014), and deaths from liver disease have increased by over 400% since the 1970s (Currie et al, 2015). Unlike the UK, most other European countries have seen death rates from severe alcohol-related liver disease fall in recent years (CMO report, 2013; Currie et al, 2015).

Worldwide, the costs of harmful drinking are high and wide-reaching. The direct economic costs of alcohol consumption include costs to health services of emergency response, hospital admissions, ambulatory care and prescriptions; costs to social care of social worker input, nursing home care and home-based support; and costs to the criminal justice system including damage to property from accidents, arrests from assaults and domestic violence and crime (Schomerus et al, 2011; WHO, 2014). Indirect costs include lost productivity due to absenteeism, premature morbidity or death, unemployment and lower earning potential (Schomerus et al, 2011).

In the UK it is estimated that direct costs of alcohol to the NHS are £3.5 billion annually, with 80% of those costs attributable to hospital based care (House of Commons, 2012). In hospitals, the impacts of alcohol are seen in emergency departments, inpatient wards and outpatient services. In 2015/16 more than a quarter of the 1.1 million alcohol-related hospital admissions in England were to treat conditions entirely caused by alcohol (National Statistics, 2017). In particular, people with chronic conditions caused wholly by alcohol are known to place a disproportionately large burden on emergency departments and hospital inpatient beds (Phillips, Coulton and Drummond, 2016).

The wider costs to society of alcohol in England are estimated at £21bn, £11bn of which are in the criminal justice sector (HM Government, 2012). Alcohol-related crime includes drink driving offences, antisocial behavior and a large proportion of violent offences including homicide, domestic violence, sexual assault and child abuse (Law Commission, 2009). In 2003 it was estimated that up to 17 million working days were lost annually through alcohol-related absence (hangover, reduced productivity after workplace drinking and sickness absence due to prolonged alcohol misuse) and up to 20 million working days are lost through loss of employment or reduced employment opportunities (WHO, 2014).

The research presented here focuses on people who use UK NHS hospital based services as a result of alcohol. In particular, the study group of interest are those who have multiple inpatient hospital admissions per year, caused by alcohol, known as “alcohol-related frequent attenders (ARFAs)”. This chapter introduces the concept of the alcohol-related frequent attender; alcohol and its effects on health outcomes at the individual and population levels; and what is already known about alcohol and health inequalities.

1.2 Alcohol and the health of individuals

Alcohol is a widely used psychoactive substance with dependence-producing properties and can be consumed legally in the UK (WHO, 2014). In the UK alcohol consumption or intake is measured in units and one unit is defined as 8g (or 10ml) of pure ethanol (NICE, 2011). In the UK, the average annual consumption of alcohol per capita (age 15 years+) between 2008-2010 was 11.6 litres of pure alcohol: 16.5 litres for males and 6.9 litres for females (WHO, 2014).

There are 3 main direct mechanisms of harm resulting from alcohol consumption:

- alcohol has a toxic effect on organs and tissues;
- intoxication, which can result in reduction of physical coordination, reduced consciousness, impairment of cognitive processes, perception, affect or behaviour; and
- dependence- whereby the drinker has impaired control over their drinking habits.

The harm caused by alcohol is also dependent on an individual's "vulnerabilities" or personal make-up, including age, gender, familial and genetic factors as well as socio-economic status (WHO, 2014). These are described in more depth later in this chapter (sections 1.4.1 - 1.4.7). At the societal level vulnerability factors also impact and these include the level of development of a country, its culture, drinking context, alcohol production and distribution and alcohol regulation.

Alcohol can be consumed at various levels which can be categorized according to the risk of developing particular health outcomes at each level of drinking, based on the following descriptions:

- low risk, where the effects of alcohol cause little or no risk to an individual's health status (CMO, 2016);
- hazardous levels, indicative of a pattern of alcohol consumption that increases someone's risk of harm but is not yet causing harm (NICE, 2010);
- harmful use, consuming alcohol at a level that "causes detrimental health and social consequences for the drinker, the people around the drinker and society at large, as well as the patterns of drinking that are associated with increased risk of adverse health outcomes." (WHO, 2010);
- Alcohol dependence is defined as "a cluster of behavioural, cognitive and physiological phenomena that develop following repeated alcohol use and that typically include a strong desire to consume alcohol, difficulties in controlling its use, persisting in its use despite harmful consequences, a higher priority given to alcohol use than to other activities and obligations, increased tolerance, and sometimes a physical withdrawal state" (WHO, 2016).

In 2010 in the UK, the 12-month age-standardised prevalence of alcohol use disorders amongst adults was estimated at 17.5% (13.4-21.5% 95% CI) and 6.7% (4.0-9.4% 95% CI) in men and women respectively (WHO, 2014). The 12-month prevalence of alcohol dependence during 2010 was estimated as 8.7% for males and 3.2% for females (WHO, 2014).

1.2.1 Alcohol as a risk factor for disease and death

Alcohol is known to be a causal factor in more than 200 disease and injury-related conditions (WHO, 2016) and increased levels of consumption are associated with a risk of developing health problems including alcohol dependence, liver cirrhosis, cancers and injuries (WHO, 2004; Baan et al, 2007; Shield, Parry and Rehm, 2013). The following diseases are known to be causally related to alcohol (WHO, 2014):

- neuropsychiatric conditions including alcohol use disorders, epilepsy, depression, anxiety;
- gastrointestinal diseases: liver cirrhosis, pancreatitis. Higher levels of alcohol consumption create an exponential increase in risk of disease;
- cancers: alcohol is considered carcinogenic for mouth, nasopharynx, oropharynx, laryngeal, oesophageal, colon, rectal, liver and female breast cancers. The higher the alcohol consumption, the greater the risk of these cancers;
- injuries: both intentional including suicide and violence and unintentional injuries. The effect of alcohol on unintentional injuries is strongly linked to alcohol concentration in the blood and effects on psychomotor function;
- cardiovascular disease- alcohol has harmful effects on hypertension, atrial fibrillation and haemorrhagic stroke. The beneficial cardio-protective effect of low levels of drinking for ischaemic heart disease and stroke disappear with the occurence of heavy drinking occasions;
- fetal alcohol syndrome and complications of premature birth;
- diabetes mellitus. Whilst a low risk pattern of drinking may be beneficial, heavy drinking is harmful; and
- infectious diseases: harmful use of alcohol increases the risk of developing pneumonia and tuberculosis. There is a strong association between alcohol consumption and HIV infection and sexually transmitted diseases (Lönnroth et al, 2008; Rehm et al, 2009; Baliunas et al, 2010; Azar et al, 2010).

For most diseases and injuries causally impacted by alcohol, there is a dose–response relationship. For example, for all alcohol-attributable cancers, the higher the consumption of alcohol, the greater the risk of developing these cancers is; and drinking any alcohol at all increases the risk of developing the cancer i.e. there is no lower threshold of consumption that is without risk for these particular conditions (IARC, 2010; WHO, 2014).

In addition, the pattern of drinking over time also influences risks of harm (Rehm et al, 2003) as does the volume of alcohol consumed on a single occasion. Heavy episodic drinking (HED- defined as the consumption of 60 or more grams of pure alcohol on at least one single occasion at least monthly), is linked to alcohol poisoning, injury and violence. In 2010, 27.1% (23.7-30.4% 95% CI) of the age-standardised UK population aged over 15 years were heavy episodic drinkers: 37.2% (32.1-42.4% 95% CI) of all males and 16.8% (12.8-20.7% 95% CI) of all females (WHO, 2014).

Heavy chronic alcohol consumption increases the risk of mental health disorders including depression, anxiety, psychosis, impairments of memory and learning, alcohol dependence and an increased risk of suicide (NICE, 2011). People who are alcohol dependent are known to suffer higher levels of comorbidity with other mental health conditions, such as depression, anxiety, post-traumatic stress disorder (PTSD), psychosis and drug misuse, compared to the general population (NICE, 2011). The physical effects of heavy chronic alcohol consumption are also seen in diseases such as alcoholic cirrhosis of the liver. In 2012 in the UK, the age-standardised death rates for males from liver cirrhosis was 16.0 per 100,000 population aged over 15 years, with 72.1% of those deaths attributable to alcohol. For females aged over 15 years during the same year, the age-standardised death rate from liver cirrhosis was 8.0 per 100,000 population aged over 15 years, with 68.2% of those deaths attributed to alcohol (WHO, 2014).

Accidents resulting in both injury and death can be directly attributed to alcohol. In 2012 in the UK, the age-standardised death rates for males from road traffic accidents was 5.9 per 100,000 population aged over 15 years, with 16.6% of those deaths attributable to alcohol. For females aged over 15 years during the same year, the age-standardised death rate from road traffic accidents was 1.8 per 100, 000 population aged over 15 years, with 6.7% of those deaths attributed to alcohol (WHO, 2014).

In figure 1 below, the distribution of alcohol attributable deaths globally by broad disease category is shown for 2012 (WHO, 2014). In total there were 3.3 million deaths attributable to alcohol, the equivalent of 5.9% of all deaths. Gastrointestinal disorders (including cirrhosis) and cardiovascular disease and diabetes were responsible for most deaths.

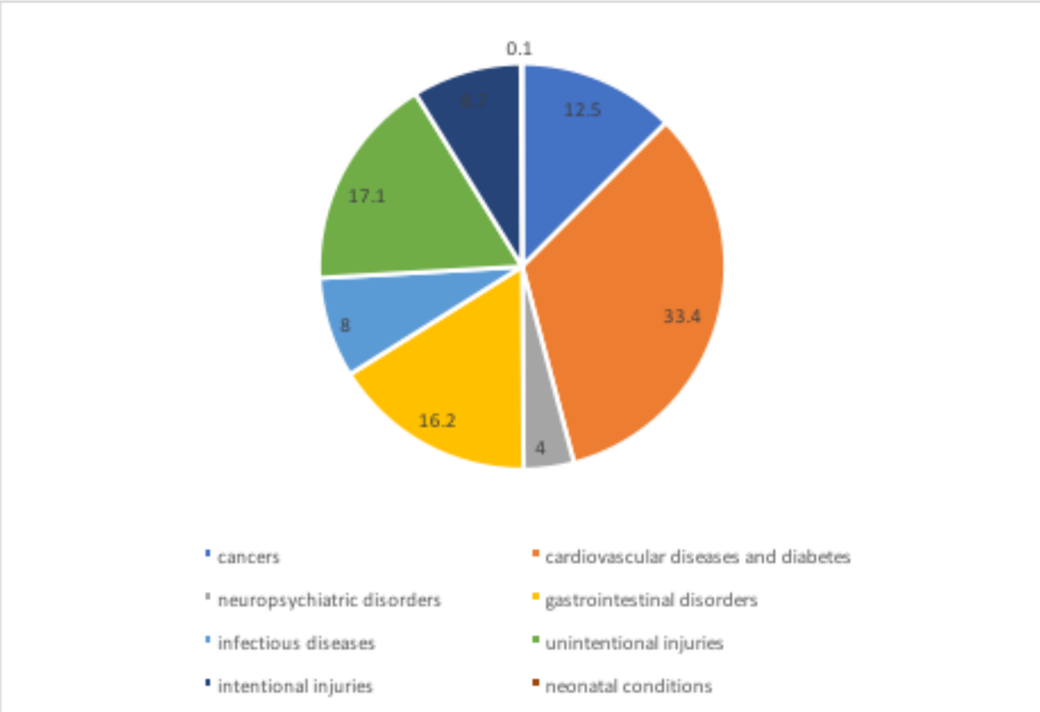

Figure 1: Distribution of alcohol-attributable deaths, as a percentage of all alcohol-attributable deaths by broad disease category, 2012.
Source: WHO Global status report on health and alcohol (WHO, 2014)

1.2.2 Individual's health status as a risk factor for alcohol consumption

There are known links between physical and mental health problems and alcohol consumption. A study in 2003 surveyed drinking habits amongst 200 adults admitted to inpatient mental health services: 22% of the total population were alcohol dependent and 49% of patients were hazardous and harmful drinkers (Barnaby et al, 2003). Hazardous, harmful and dependent drinking are all associated with a higher risk of suicidal behaviour. A study of patients attending specialist alcohol treatment services showed that 85% of all patients had a current psychiatric disorder in addition to their alcohol dependence comprising affective or anxiety disorder (81%), personality disorder (53%) and psychotic disorder (19%)(Weaver et al, 2003). Heavy and excess drinking can be triggered by adverse life events (NICE, 2011).

1.3 Alcohol and the UK health service

England's hospitals are experiencing an increasing alcohol-related burden. Alcohol related hospital admissions have doubled in the last 8 years in England and reducing this burden is a key priority of government public health strategy (PHE, 2014; CMO report, 2013). Between 2005/06 and 2013/14, alcohol attributable inpatient admissions increased by 63.6%: there was a 143.3% increase in elective admissions (from 45.5 per 100,000 population to 110.8 per 100,000 population) and a 53.9% increase in emergency admissions (from 374.9 per 100,000 population to 577.1 per 100,000 population). In 2013/14, approximately 1 in 20 emergency admissions were for alcohol-attributable conditions (CMO report, 2013). The relative increase in hospital admissions from alcohol seen since 2002/03-2013/14 has been larger than that for non-alcohol attributable admissions (Currie et al, 2015).

As well as on the inpatient wards, the effects of alcohol are also seen in the accident and emergency (A&E) departments in UK hospitals, where patients may just attend for a few hours or may go on to be admitted as an inpatient. It is estimated that 1-2% of attendances to UK accident and emergency (A&E) departments are made by 'frequent attenders' (who also use other health and social care facilities frequently) and of those, 6.7% are alcohol-related frequent attenders (Green, 2017; Royal College of Emergency Medicine, 2014). Twenty-one hospitals in England have specific clinical pathways for alcohol-related frequent attenders (ARFAs) (PHE, 2014), but there is no single definition in terms of the number of visits to hospital a patient must have to be classified as a frequent attender (as discussed further in chapter 2) and there is currently no universal way of recording and monitoring ARFA hospital admissions/attendances, so the true burden on the NHS cannot yet be quantified (PHE, 2014; Barnaby et al, 2003). There have been recent calls for further research into the predictors of frequent use of healthcare services, supporting the notion that these subgroups are inadequately defined (Cheeta et al, 2008; Pines et al, 2011; PHE, 2014).

Local research from Guy's and St Thomas' NHS Foundation Trust, London UK, suggests that frequent attenders to hospital for alcohol related conditions (alcohol related frequent attenders, ARFAs) use a disproportionately large share of NHS resources (Blackwood, Lynskey and Drummond, 2017). This is illustrated by figure 2 below which shows that in 2013/14, 26.6% of all patients with an alcohol-related hospital admission at Guy's and St Thomas' Hospitals, were admitted more than three times during the year, and were responsible for 59.6% of all of the alcohol-related hospital admissions at the Trust that year.

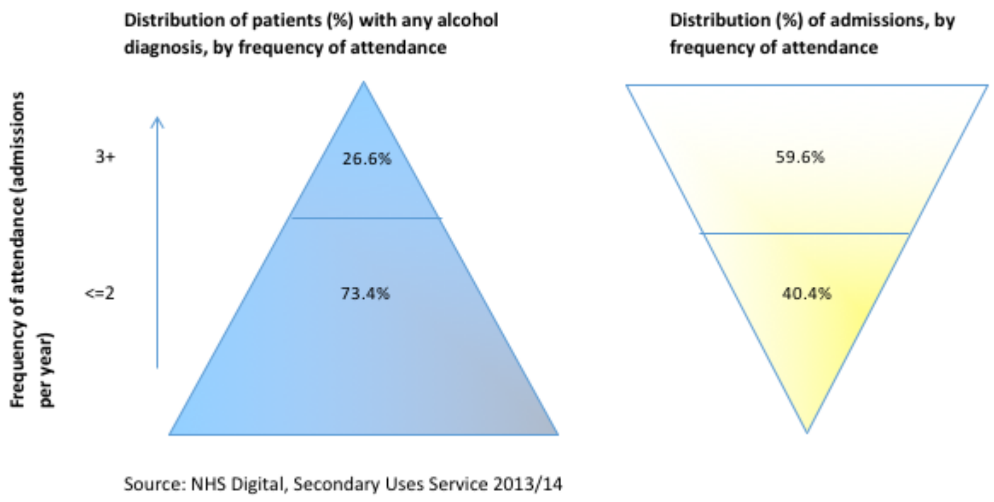

Figure 2: Frequency of alcohol related hospital admissions to Guy's and St Thomas' NHS Foundation Trust, 2013/14

Despite being responsible for a large proportion of all alcohol-related hospital admissions, little is known about the characteristics of alcohol-related frequent attenders in terms of their age, gender, socio-economic status, concurrent health status (comorbidities) and their long-term health outcomes. This thesis presents the results of a systematic review and four new population studies which collectively aim to increase knowledge of this resource-intensive group of patients, identifying their socio-demographic characteristics, patterns of health service use, outcomes and costs to the NHS.

1.3.1 Alcohol-related attendances to hospital and alcohol-attributable fractions

Alcohol-related attendances at hospital can be due to conditions which are caused entirely by alcohol, known as wholly alcohol-attributable conditions, and those caused in part by alcohol, known as partially alcohol-attributable conditions.

The extent to which alcohol contributes to the cause of a condition can be described by the alcohol-attributable fraction (AAF). Alcohol attributable fraction values, also known as population attributable fractions, range between

0 and 1 and are the proportion of a health condition attributable to the exposure to alcohol in a given population. Conditions wholly attributable to alcohol have an AAF of 1, and those only partially attributable to alcohol have an AAF of greater than 0 and less than 1 (Jones and Bellis, 2013).

Conditions wholly attributable to alcohol (AAF=1) and their diagnostic coding according to the International Classification of Diseases, version 10 (ICD10) are shown in table 1 below (Jones and Bellis, 2013) and partially attributable alcohol diagnoses and their AAFs are shown in table 2.

Table 1: Conditions identified as being wholly attributable to alcohol and their ICD10 diagnostic codes; Jones, (2013).

ICD10 codes	ICD10 Diagnosis
F10 Mental and behavioural disorders due to use of alcohol	
F10.0	Acute intoxication
F10.1	Harmful use
F10.2	Dependence syndrome
F10.3	Withdrawal state
F10.4	Withdrawal state with delirium
F10.5	Psychotic disorder
F10.6	Amnesic syndrome
F10.7	Residual and late-onset psychotic disorder
F10.8	Other mental and behavioural disorders due to the use of alcohol
F10.9	Unspecified mental and behavioural disorders due to the use of alcohol
K70 Alcoholic liver disease	
K70.0	Alcoholic fatty liver
K70.1	Alcoholic hepatitis
K70.2	Alcoholic fibrosis and sclerosis of liver
K70.3	Alcoholic cirrhosis of liver
K70.4	Alcoholic hepatic failure
K70.9	Alcoholic liver disease, unspecified
T51 Toxic Effect of Alcohol	
T51.0	Ethanol poisoning
T51.1	Methanol poisoning
T51.9	Toxic effect of alcohol, unspecified
Other conditions	
E24.4	Alcohol-induced pseudo-Cushing's syndrome
G31.2	Degeneration of nervous system due to alcohol
G62.1	Alcoholic polyneuropathy
G72.1	Alcoholic myopathy
I42.6	Alcoholic cardiomyopathy
K29.2	Alcoholic gastritis
K85.2	Alcohol-induced acute pancreatitis
K86.0	Alcohol-induced chronic pancreatitis
Q86.0	Fetal alcohol syndrome (dysmorphic)
R78.0	Excess alcohol blood levels
X45	Accidental poisoning by and exposure to alcohol
X65	Intentional self-poisoning by and exposure to alcohol
Y15	Poisoning by and exposure to alcohol, undetermined intent
Y90	Evidence of alcohol involvement determined by blood alcohol level
Y91	Evidence of alcohol involvement determined by level of intoxication

Table 2: Conditions identified as being partially attributable to alcohol and their ICD10 diagnostic codes and alcohol attributable fraction (AAF); Jones, (2013).

Diagnostic group	ICD10 codes	ICD10 Diagnosis	AAF
Infectious diseases	A15-A19	Tuberculosis	0.09-0.25
Malignant neoplasm	C00-C14	Lip, oral cavity and pharynx	0.18-0.47
	C32	Larynx	0.13-0.31
	C15	Oesophagus	0.33-0.56
	C18, C20	Colorectal	0.08-0.14
	C22	Liver and intrahepatic bile ducts	0.07-0.13
	C50	Breast	0.09-0.11
Metabolic diseases	E11	Diabetes mellitus	-0.04- -0.24
Neurological conditions	G40-G41	Epilepsy	0.12-0.27
Cardiovascular disease	I10-I15	Hypertensive diseases	-0.27-0.19
	I20-I25	Ischaemic heart disease	-0.13-0.09
	I47-I48	Cardiac arrhythmias	0.07-0.13
	I60-I62, I69.0-I69.2	Haemorrhagic stroke - mortality	0.09-0.19
		Haemorrhagic stroke - morbidity	-0.21-0.18
	I63-I66, I69.3-I69.4	Ischaemic stroke- mortality	-0.21 --0.02
		Ischaemic stroke - morbidity	-0.04- -0.02
	I85	Oesophageal varices - mortality	0.36-0.62
		Oesophageal varices - morbidity	0.22-0.50
Respiratory infections	J10.0, J11.0, J12-J15, J18	Pneumonia	0.02-0.15
Digestive disease	K73, K74	Unspecified liver disease - mortality	0.36-0.62
		Unspecified liver disease - morbidity	0.22-0.50
	K80	Cholelithiasis (gall stones)	-0.25 - -0.11
	K85, K86.1	Acute and chronic pancreatitis	0.08-0.25
Pregnancy and childbirth	O03	Spontaneous abortion	0.08-0.11
	P05-P07	Low birth weight	0.05
Unintentional injuries	See note 1 below	Road/pedestrian traffic accidents - mortality	0.03-0.46
		Road/pedestrian traffic accidents - morbidity	0.02-0.31
	X40-X49 (excl X45)	Poisoning - mortality	0.04-0.38
		Poisoning - morbidity	0.02-0.17
	W00-W19	Fall injuries - mortality	0.04-0.37
		Fall injuries - morbidity	0.02-0.18
	X00-X09	Fire injuries - mortality	0.04-0.38
		Fire injuries - morbidity	0.02-0.17
	W65-W74	Drowning - mortality	0.04-0.38
		Drowning - morbidity	0.02-0.18
	See note 2 below	Other unintentional injuries - mortality	0.04-0.38
		Other unintentional injuries - morbidity	0.02-0.17
Intentional injuries	X60-X84, X87.0 (excl X65)	Intentional self-harm – mortality	0.04-0.38
		Intentional self-harm - morbidity	0.02-0.38
	Y10-Y34, Y87.2 (excl Y15)	Event of undetermined intent - mortality	0.04-0.38
		Event of undetermined intent - morbidity	0.02-0.18
	X85-Y09, Y87.1	Assault - mortality	0.04-0.38
		Assault - morbidity	0.02-0.18

Note 1: includes ICD-10 codes V021-V029, V031-V039, V041-V049, V092, V093, V123-V129, V133-V139, V143-V149, V194-V196, V203-V209, V213-V219, V223-V229, V233-V239, V243-V249, V253-V259, V263-V269, V273-V279, V283-V289, V294-V299, V304-V309, V314-V319, V324-V329, V334-V339, V344-V349, V354-V359, V364-V369, V374-V379, V384-V389, V394-V399, V404-V409, V414-V419, V424-V429, V434-V439, V444-V449, V454-V459, V464-V469, V474-V479, V484-V489, V494-V499, V504-V509, V514-V519, V524-V529, V534-V539, V544-V549, V554-V559, V564-V569, V574-V579, V584-V589, V594-V599, V604-V609, V614-V619, V624-V629, V634-V639, V644-V649, V654-V659, V664-V669, V674-V679, V684-V689, V694-V699, V704-V709, V714-V719, V724-V729, V734-V739, V744-V749, V754-V759, V764-V769, V774-V779, V784-V789, V794-V799, V803-V805, V811, V821, V830-V833, V840-V843, V850-V853, V860-V863, V870-V878, V892

Note 2: includes ICD-10 codes V01, V090, V091, V099, V100-V109, V110-V119, V120-122, V130-132, V140-V142, V150-V159, V160-V169, V170-V179, V180-V189, V191-V193, V20-V28: 0.1–0.2; V290-V293, V30-V38: 0.1–0.2; V390-V393, V40-V48: 0.1–0.2; V490-V493, V50-V58: 0.1–0.2; V590-V593, V60-V68: 0.1–0.2; V690-V693, V70-V78: 0.1–0.2; V790-V793, V800, V801, V806–V809, V810, V812–V819, V820, V822–V829, V834–V839, V844–V849, V854–V859, V864–V869, V879, V88, V890, V891, V893–V899, V90-V94, V95-V97, V98-V99, W20-W52, W75-W84, W85–W99, X10-X19, X20-X29, X30-X33, X50-X57, X58, X59, Y40-Y84 Y85, Y86, Y88, Y89

1.4 Health inequalities and alcohol

Alcohol affects population groups of different social and economic standing unequally (Jones et al, 2015; Probst et al, 2014). People with lower income, education or occupational status are more likely to die or suffer morbidity as a consequence of their alcohol use (Makela, 1999; Romelsjo and Lundberg, 1996; Van Oers et al, 1999). People working in routine occupations have an alcohol-related death rate between 3 and 6 times higher than those in the highest occupational positions (SIegler et al, 2011; Jones and Sumnall, 2016).

It is unclear why inequalities in alcohol-attributable and alcohol-related deaths between population groups exist, because there is little evidence of a difference or gradient in alcohol consumption across the social groups to explain these observed differences in health outcomes. This phenomenon of disproportionate harm from alcohol affecting disadvantaged populations is known as the alcohol harm paradox (Katikireddi et al, 2017; Bellis et al, 2015).

Efforts to reduce health inequalities in the UK have been a major focus of UK government health policy for more than 30 years and more recently include specific reference to alcohol (Williams, 2014). The impact of health inequalities is estimated to cost the UK £31-33 billion per year in terms of illness, lost revenue from taxes and reduced productivity, in addition to £20-32 billion per year in welfare payments that are due to poor health (Acheson, 1998). Inequalities are present at every age and for all major disease groups in the UK. For example, males living in the most deprived region of England in 2013 compared to those living in the least deprived region had a reduced life expectancy of 8.2 years (Newton et al, 2015).

Whilst first brought to the forefront of political discussions by the Black report (DHHS, 1980) in 1980 and later in the Acheson report in 1998 (Acheson, 1998), inequalities formed a major strand of health policy during the 2000s, and have remained on the health agenda as a result of more recent coverage such as the Marmot report (Marmot et al, 2010). In 2012 the introduction of the Health and Social Care Act compelled UK health organisations to have due regard for reducing health inequalities, and this has become a key policy objective subsequently (Health and Social Care Act, 2012).

The causation of inequalities between health and socio-economic status can be considered from the perspectives of behavioural, materialist, psycho-social and life course models (Bartley and Blane, 2008). When each of these models is considered in relation to alcohol, a more complex picture emerges.

1. The *behavioural model* suggests socio-economic group differences result in lifestyle differences therefore differences in risk exposure. Studies looking at differences in individuals' alcohol consumption across the social groups show that those living in the most deprived neighbourhoods are more likely to either abstain from alcohol (Kuipers et al, 2013; Galea et al, 2007; Chuang et al, 2007), or have heavier alcohol consumption than those living in less deprived areas (Matheson et al, 2011; Cerda et al, 2010; Stimpson et al, 2007; Fauth, Leventhal and Brooks-Gunn, 2004; Mulia and Karriker-Jaffe, 2012) and be more likely

to adopt riskier drinking strategies (Jones et al, 2015; Bellis et al, 2015). There is a higher prevalence of consumption amongst those from higher SES groups (Fuller, 2013).

2. The *materialist model* suggests that poverty exposes people to health hazards. This is similar to a social selection/social drift hypothesis: people in poverty may suffer further disadvantage as a result of problems caused by their problem alcohol use (reverse causation) such as family breakdown, loss of earnings, financial problems and unemployment, which together result in material deprivation, acute/chronic stress and psychosocial mechanisms further contributing to problem alcohol use (Bartley and Blane, 2008).

3. The *psychosocial model* or social causation hypothesis: low socio-economic status results in material deprivation and associated acute or chronic stress and psychosocial mechanisms further contribute to problem alcohol use. However there remain gaps in the evidence around the mechanisms by which problem alcohol use results (Mäkelä and Mustonen, 2000).

4. The *lifecourse model*: health outcomes are ultimately influenced by the patterns of social, psycho-social and biological advantages and disadvantages experienced by an individual over time. In relation to alcohol, “third factors” affecting both socioeconomic status and drinking such as age, sex, ethnicity, marital status and risk behaviours. These factors can result in material deprivation, acute/chronic stress and psychosocial mechanisms further contributing to problem alcohol use.

At the individual level alcohol is known to be a risk factor for many diseases as previously discussed in section 1.2.1, but at the population and societal level the impact of alcohol is more widespread. As illustrated by Dahlgren and Whitehead’s (1991) model of the wider determinants of health (figure 3 below), showing the factors which influence a person's health and well-being beyond an individual's age, sex and other constitutional factors, the opportunities for alcohol to affect those determinants of health outwith an individual's direct control can be seen.

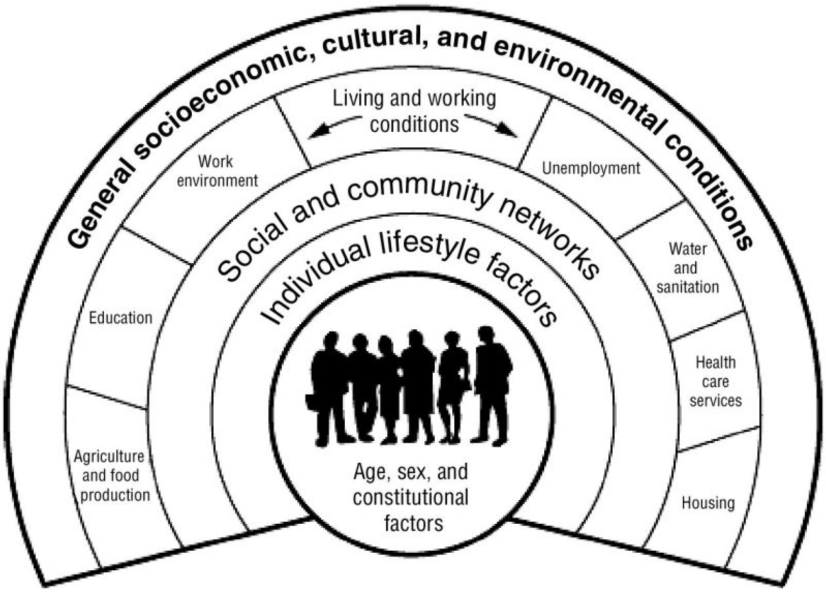

Figure 3 : The wider determinants of health (Dahlgren and Whitehead, 1991)

As well as being an "individual lifestyle risk factor", alcohol exerts an additional effect on general socioeconomic and cultural conditions, education, unemployment, living and working conditions, health care services and social and community networks. And indeed some of those determinants themselves such as general socioeconomic, cultural, living and working conditions, housing/homelessness, age, sex and constitutional factors will influence an individual's propensity to drink alcohol and also contribute to health inequalities.

The multi-level and multi-directional effects and influences of alcohol across society, particularly in relation to health inequalities and the demographic data available in hospital episode statistics (HES) are each discussed in subsequent sections of this chapter. All these elements impact on the lifecourse model of health inequalities previously described.

1.4.1 Age and alcohol

The effects of alcohol vary with age: children, adolescents and the elderly are more vulnerable to alcohol-related harm from a given volume of alcohol than working age adults (Hilton, 1987; Midanik and Clark, 1995; Mäkelä and Mustonen, 2000). Alcohol-related motor vehicle accidents and other unintentional injuries appear to account for part of the excess risk of harm from alcohol among young people, compounded in part by a propensity for young people to consume alcohol in heavy drinking spells and engage in risk taking behaviour while intoxicated (WHO, 2014). Early age of onset of drinking (before 14 years of age) is associated with an increased risk of alcohol dependence in later years (Grant and Dawson, 1997).

Many studies report that alcohol consumption decreases with age (Fillmore, 1987; Kerr, Fillmore and Bostrom, 2002; Moos et al, 2009; Fillmore et al,1991; Britton et al, 2015) though older drinkers typically consume alcohol more frequently than other age groups (WHO, 2014). With increasing age, the body metabolises alcohol more slowly so blood alcohol levels remain higher for longer, potentially resulting in a high burden of unintentional injuries relating to alcohol such as falls (WHO, 2014).

Life course trajectories of drinking in the UK created from synthesis of data from multiple cohorts show that for men, mean alcohol consumption rises sharply during adolescence, peaks at around 25 years at 20 units per week, then declines and levels off during mid-life, before falling again from around age 60 (Britton et al, 2015). In women, consumption peaks at a similar age to men (25 years) at a lower total intake of 7-8 units per week, before declining in a similar pattern to men. Frequent drinking (daily or most days of the week) becomes more common during middle to older age, and affects more than 50% of men (Britton et al, 2015).

Looking at age and burden on health services in the UK, during 2013/14, men aged 45–64-year-old had the highest rate of emergency admissions compared to other groups (1,126.0 per 100,000 population) and this may reflect the chronicity of alcohol-related diagnoses and the contribution of alcohol to many long-term conditions that are more prevalent in older age groups (Currie et al, 2015).

1.4.2 Poverty and alcohol

In relation to the impact of socioeconomic status over the lifecourse, findings from the 1958 British Birth Cohort Study, following the lives of 17,000 people born in England, Wales and Scotland during a single week in March 1958, found that low socio-economic status during childhood was associated with an increase in problematic midlife drinking (Caldwell et al, 2008). In the same study and another study (Batty et al, 2008) cumulative disadvantage over the lifecourse was found to be the strongest predictor of drinking patterns: disadvantage in childhood and adulthood resulted in an increased risk of midlife problem drinking. Across all ages, men with low socioeconomic status reported binge drinking more often than those of higher socioeconomic status; whereas for women, at younger ages lower socioeconomic women were less likely to binge drink than higher socioeconomic status, but at older ages for women, the reverse was true (Jefferis, Manor and Power, 2007). There is a strong link between alcohol-related deaths and socioeconomic deprivation, with higher death rates seen in more deprived areas. The most socioeconomically deprived 20% of the population for England and Wales accounted for 32% of alcohol related deaths in men and 26% of alcohol related deaths in women between 1999 and 2003 (Erskine, 2010).

1.4.3 Access to healthcare

Evidence suggests that it may be harder for those living in more disadvantaged circumstances to access health and alcohol related services than those less disadvantaged, due to barriers such as travel costs, transport, distance, not being able to take time off work and stigma (Probst et al, 2014). Also there may be a fear that access to welfare benefits may be affected if help is sought (Katikireddi et al, 2017).

1.4.4 Gender and alcohol

Seven point six percent of all male deaths in 2012 were attributable to alcohol, compared to 4.0% of female deaths and harmful use of alcohol is the leading risk factor for death in males aged 15-59 years. The difference in burden between males and females may largely be explained by different patterns of consumption. However as women's drinking levels increase, the vulnerability of women to harm from alcohol is a growing concern. The vulnerability of women may be explained by a wide range of factors including having lower body weight than men, higher proportion of body fat and different rates of liver metabolism resulting in women having the same blood alcohol levels as men for a smaller level of alcohol consumption (WHO, 2014).

1.4.5 Ethnicity and alcohol

Alcohol-related mortality within the UK varies according to a person's country of birth. For example, there is a higher alcohol-related mortality rate among those born in Ireland, Scotland and India compared to those born in Bangladesh, China, Hong Kong, Pakistan, the Middle East, West Africa and the West Indies (Bhala et al, 2009). Ethnic composition of neighbourhoods has been hypothesised as influencing social norms for alcohol use in an area and thus may explain lower rates of hazardous drinking in deprived neighbourhoods (Kuipers et al, 2013). In the UK while Black and Minority Ethnic groups do tend to have higher rates of abstinence and lower levels of alcohol consumption than white populations, they have similar levels of alcohol dependence compared to the general population (Hurcombe, 2010).

1.4.6 Genetics factors and alcohol

Inherited or genetic risk factors are known to account for a substantial proportion of the variation in alcohol dependence. Family history of alcohol use disorder is a vulnerability factor for both genetic and environmental reasons (WHO, 2004). Multiple genes affect metabolism and reinforcement of alcohol consumption meaning that some individuals are susceptible to the effects of alcohol depending on the expression of those genes (Mayfield, Harris and Shuckit (2008). Furthermore, parental alcohol use disorders have been found to negatively affect the family situation during childhood. Parents with alcohol use disorders display particular patterns of alcohol consumption and thereby increase the likelihood that their children will develop drinking patterns associated with high risk of alcohol use disorders when they are introduced to alcohol (WHO, 2014).

1.4.7 Other factors influencing the lifecourse

Unemployment adversely affects health and wellbeing in general and experience of unemployment by age 33 years has been associated with greater risk of being a problem drinker (Montgomery et al, 1998). There is a high prevalence of alcohol misuse (as well as mental and physical health and social problems) amongst people who are homeless. The prevalence of alcohol use disorders in the homeless population has been reported to be between 38 and 50% in the UK (NICE, 2011).

1.5 Alcohol related frequent attenders to hospital

The concept of an alcohol related frequent attender was described in detail in 1964 by Edwards (1964) who described the “circulating alcoholic”, a patient drifting in and out of care between hospitals, primary care and contacts with the criminal justice system. Subsequently, various different terms have been coined for the “frequent attender” which is a notion recognised across the specialties and diagnoses, not just in relation to alcohol. In addition to “circulating alcoholic” and “frequent attender”, nomenclature includes “revolving door” (Rabinowitz et al 1995), “high impact users” (Bottle, Aylin and Majeed, 2006), ”frequent flyer” (Rosenblatt and Mayer, 1974), and phrases incorporating “readmission” of/and “alcoholics” (Booth, Yates, Petty, 1991; Slater and Linn, 1982; NDC Scotland, 2013). Links have also been made to terms such as “recidivist” (Labbate and Doyle, 1997; Larson, Burton, Kashiwagi, 2012; Booth, Yates, Petty, 1991). Most of these labels have negative or stigmatising connotations. More recently the term “super-utilizer” has been used, mostly in commentary originating from the United States (Cavanaugh, 2017; Gawande, 2011).

ARFAs typically have high levels of multimorbidity, including both physical and mental illness, social isolation, poor quality of life, unstable housing or homelessness, high criminal justice involvement, unemployment and low socio-economic status (Kent and Yellowlees, 1994; Schomerus et al, 2011; Skinner, Carter and Haxton, 2009; Mannix et al, 2014; Hughes et al, 2013; Parkman et al, 2017; Neale et al, 2017). ARFAs tend to be older than alcohol-related non-frequent attenders (Smyth, 2011; McCormack et al, 2013) and racially diverse (McCormack, Goldfrank and Rotrosen, 2014). Notably, they either have poor or no engagement with existing specialist alcohol treatment services (Passetti et al, 2008). Qualitative research has also identified that ARFAs experience high levels of stigma and social exclusion (Schomerus et al, 2011; Parkman et al, 2017; Neale et al, 2017).

A 2017 study which reported findings from in-depth interviews with 30 alcohol related frequent attenders to London A&E departments found that reasons given for continued heavy drinking among the frequent attenders included self-medicating physical, health and social problems; and to be able to perform normal activities of daily living such as getting dressed. Multiple participants in the study said that homelessness had a negative impact on their health, and made them drink more. Almost one third of interviewees had a formal mental health diagnosis, others reported psychiatric symptoms but had not been formally diagnosed, and almost all participants spoke of multiple chronic physical health problems as a result of their drinking (Neale et al, 2017). In relation to those people being admitted to hospital for alcohol problems on a frequent basis, the complexity of problems seen in those who frequently attend emergency departments may only be the tip of the iceberg, as alcohol misuse and dependence is known to be under-identified in clinical settings (NICE, 2011).

Although there is no standardised definition of a patient with “complex needs” some patients certainly need more time and resources during their hospital stay than others. Factors which have been proposed as important elements of patients becoming complex include age and co-morbidity, with other characteristics including polypharmacy, psychiatric illness, communication problems, aggressive behaviour, substance misuse and need for coordination of care (Aujesky, Donze and Crelier, 2016).

An indepth study of 30 alcohol related frequent attenders (Neale et al, 2017) revealed that many ARFAs experience mental health problems in combination with chronic physical health problems, homelessness and alcohol and drug misuse, certainly highlighting their complexity. Until now, the prevalence of alcohol related frequent attenders in England was not known, so the scale of the number of patients living with alcohol problems coupled with other complex needs was unclear. Furthermore, the full extent of their concomitant physical and mental health problems has also not been known. In 2015 it was estimated that 60,000 people in the UK were experiencing multiple serious needs including mental health problems, alcohol and drug misuse, offending, family breakdown and homelessness (Drinkwater et al, 2015). It has been estimated that 24% of alcohol treatment clients also had offending or housing needs (Bramley et al, 2015). In addition, little has been known about the longer-term health outcomes for alcohol-related frequent attenders including mortality and indeed whether ARFAs experience health inequalities compared to other patient groups.

1.6 Summary and aims of the research

The research presented in this thesis focuses on people who frequently use UK NHS hospital based services as a result of alcohol. In particular, the study group of interest are those who have multiple inpatient hospital admissions per year, caused by alcohol, known as alcohol-related frequent attenders.

As this chapter has highlighted, this group are a high-cost high-need patient group, yet little is known about their socio-demographic characteristics, their longer-term health outcomes and their patterns of health service use, in particular in the period prior to them becoming an ARFA. This chapter has summarised some of the factors known to influence alcohol intake, the impact alcohol can have on an individual's health, and the relationship between alcohol and health inequalities. This research aims to increase knowledge about alcohol related frequent attenders and the factors that influence their health service utilisation and outcomes. Specifically the research aims to:

1. Identify in a sample of hospital attenders, which medical and socio-demographic characteristics are associated with alcohol-related frequent attendance and different patterns of health service utilisation.
2. Identify in a sample of alcohol-related frequent attenders, whether future health service usage can be determined by service-user characteristics.
3. Estimate the costs to the UK health service of inpatient stays for alcohol-related frequent attenders.

This thesis will explore the following research questions:

- Do ARFAs account for a disproportionately larger share of inpatient bed days than other patient groups?

- Do ARFAs have more medical and psychiatric co-morbidities (i.e. are more complex) than other types of frequently or non-frequently admitted patients?
- Is there is a higher prevalence of ARFAs in the most deprived geographical areas compared to the least deprived?
- Can medical and socio-demographic characteristics predict transition to alcohol related frequent attendance?
- Do ARFAs have poorer health outcomes compared to other frequent attenders including shorter survival?
- Does the cost of health service usage by ARFAs represents a disproportionately large burden to the NHS compared to other service users?

Firstly, the systematic review summarises the existing literature on alcohol-related frequent attenders, their characteristics, demographics and what is known about their patterns of health service use.

In subsequent chapters, the results of four hospital-based studies of alcohol-related frequent attenders using data from England's hospital episode statistics (HES) are presented. The four studies identify cohorts of alcohol-related frequent attenders and compare their socio-demographic characteristics, concurrent clinical conditions (comorbidities), mortality rates and health service use (and costs) with other frequent and non-frequent attenders to hospitals and explores differences and inequalities between those groups.

2 The nature, natural history and characteristics of alcohol related frequent attenders: a systematic review

2.1 Background

The concept of an alcohol related frequent attender (ARFA) linked to alcohol was described in detail in 1964 by Edwards who described the "circulating alcoholic", a patient drifting in and out of care between hospitals, primary care and the criminal justice system. A case study of a patient born in 1911 highlights the problems faced by this particular patient group and their ongoing occupation of admission to hospital (Edwards, 1964):

> *"A man born in 1911, who had a stable home background. Schooling was from the age of 5 to 17 years, and he then embarked on a successful professional career but later, as a result of his drinking, declined to kitchen portering. He was twice divorced.*
> *Heavy drinking started at the age of 17, and by the age of 28 his drinking was out of control and he was experiencing morning shakes. He was not admitted to a mental hospital until, at the age of 40, he developed delirium tremens: he was in hospital for three months. During the next four years he was admitted to an observation ward following a suicidal gesture when he was drunk, and to another observation ward when he was found to have such severe peripheral neuritis that he could not walk. During this same period he was admitted to a general hospital after falling downstairs when drunk, and to another general hospital for a partial gastrectomy which was performed for a duodenal ulcer. When he was 44 he had two admissions to a mental hospital which ran a specialised alcoholism unit. At the age of 45 he had three admissions to a third general hospital, where, as well as his peripheral neuritis being treated, he received psychotherapy. When he was 46 there were two further admissions to the same general hospital; he had one night in a third mental hospital, two weeks in the third observation ward, and eight months in a fourth mental hospital. He had four more admissions to three further mental hospitals when he was 47. He spent the two years from the age of 48 to 50 in the eighth mental hospital. When he was 50 he spent six weeks in a rehabilitation hostel, and a week in one of the previous observation wards. He was then, at the age of 50, admitted to the Maudsley Hospital… He worked outside the hospital for the last month, using the ward as a night hostel. He drank only once during his*

> *year in hospital; this was when he was told that he must get a job. He was discharged to the same hostel specialising in rehabilitation of alcoholics in which he had previously been living. Within one week of discharge from the Maudsley Hospital this man relapsed in to uncontrolled drinking. He was twice admitted to one of the previous observation wards and contact with him was then lost."*

Subsequently, various different terms have been coined for the "frequent attender" which is a notion recognised across the specialties and diagnoses, not just in relation to alcohol. Edwards (1964) identified the ARFA group as being a sub-group of alcoholics. The systematic literature review presented here sought to understand what is already known about the characteristics of alcohol related frequent attenders to hospital, summarise the findings of those studies and identify gaps in current knowledge.

2.2 Aims of literature review

A systematic review of clinical and socio-demographic characteristics of ARFAs was undertaken to identify factors predisposing to frequent attending, namely:

1. What case definitions have been used in studies of ARFAs?
2. What are the socio-demographic and other characteristics of alcohol related frequent attenders?
3. How do the characteristics of ARFAs differ from non-alcohol-related frequent attenders and alcohol-related-non-frequent attenders?
4. Do any factors predict whether a person will become a frequent attender or an alcohol-related frequent attender?

2.3 Method

This systematic literature review followed methodology devised by York University (York University, 2008).

2.3.1 Search strategy

Medline (1946-), Embase (1974-), Psychinfo (1806-), and CINAHL (1981-), Cochrane databases were searched on 06/10/2015 for all years with results limited to English language and humans, using a defined search strategy and terms. The search strategy is shown below.

1. alcoho*.ti;
2. (exp AND "alcohol abuse" OR (alcohol related disorders OR alcohol induced disorders)).af;
3. ((drinker* OR "drink*adj use*") OR (alcohol* OR dink* ADJ addict* OR attenuate* OR binge* OR car* OR dependen* OR detox* OR disease* OR disorder* OR excessive* OR harm* OR hazard* OR heavy OR high risk OR intoxicat* OR misus* OR overdos* OR (over ADJ dos*) OR problem* OR rehab* OR reliant OR relaps* OR withdraw*)).ti,ab;
4. 1 OR 2 OR 3;
5. ("frequent ADJ attend*" OR "emergency ADJ attend*" OR "frequent ADJ admission" OR "frequent ADJ flier" OR "frequent ADJ flyer" OR "multiple ADJ (admission* OR attendance*)" OR "high intensity user").ti,ab;
6. "frequent attender".ti,ab;
7. "frequent flier*".ti,ab;
8. "high intensity user*".ti,ab;
9. "frequent* admissions".ti,ab;
10. "frequent* admit*".ti,ab;
11. "high impact users".ti,ab;
12. readmission*.ti,ab;
13. (frequent AND attend*).ti,ab;
14. "frequent* attend*".ti,ab;
15. 13 OR 14;
16. 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 15;
17. alcoho*.ti,ab;
18. 16 AND 17;
19. 18 [Limit to: (Language English) and Humans];
20. Duplicate filtered: [18 [Limit to: (Language English) and Humans]];

Figure 4: Search strategy for findings paper on the nature and natural history of alcohol related frequent attenders

2.3.2 Selection

Abstracts for all papers retrieved in the search were reviewed and assessed for inclusion prior to review of the full paper. Abstracts were reviewed and studies included when:

- ARFAs (or synonym) were the main subject of the study, and
- characteristics of ARFAs (or synonym) were reported, or
- predictors of admission/readmission reported.

The full criteria for the population, interventions, comparators, outcomes and types of study (PICOS) for inclusion in the search were all defined prior to the search and are shown in the PICOS table (table 3) below. The systematic review aimed to include studies of all publication type, to avoid publication bias.

During the review, snowballing of citations was undertaken to minimise the risk of omitting any key references. The Cochrane library was searched for any recent or pending systematic reviews on ARFAs. Evidence was critically appraised and synthesised.

The titles and abstracts of each paper, along with details of authors, dates and citation were entered in to a table of search results. All abstracts were screened, and the decision to include for full review or not, along with reasons for inclusion or exclusion were noted against each paper as each abstract was reviewed. If an abstract was reviewed but it was not clear from the contents of the abstract whether the paper was relevant to the review or not, the paper was included for full review to ensure that important papers were not omitted.

The full papers were retrieved for all abstracts selected for inclusion.

Table 3: PICOS table for terms included in literature search

Population	Intervention/interest	Comparator	Outcome	Studies
Adults aged >18 years Alcoholism Frequent attenders Frequent fliers High intensity user Emergency attender Readmissions Frequent readmissions Multiple admissions Multiple readmissions Multiple attendances	Any intervention for: Frequent alcohol-related hospital admissions Frequent alcohol-related A&E attendances Predictive model for (alcohol-related) frequent attender Identifying (alcohol-related) frequent attenders Frequent admissions/ Attendances Readmissions/ Multiple admissions/ Multiple attendances	Frequent non-alcohol related hospital admissions Frequent non-alcohol related A&E attendances Non-frequent-alcohol related admissions Non-frequent alcohol related A&E attendances	Hospital admissions A&E attendances Contacts with health or social services	Meta-analyses Systematic reviews RCTs Cohort studies Quantitative modeling Analysis of patient records Economic studies Epidemiological studies

2.3.3 Quality assessment

Full papers were critically appraised and the strengths and limitations of each paper were recorded in a summary table (see table 4). An assessment of the quality of each study was made on the basis of:

- appropriateness of the study design in relation to the research objective;
- risk of bias;
- choice of outcome measure;
- analytical or statistical issues;
- quality of reporting;
- quality of the intervention; and
- generalisability to other populations or settings.

2.3.4 Data extraction

Authors, publication and study year, population characteristics (age, gender, ethnicity, drinking status, hospital utilisation), study design including use of controls and analysis, primary and secondary outcomes were extracted from papers. Relevant data from each paper was recorded in a summary table (see table 4).

2.3.5 Data synthesis

Since the main aim of the systematic review was to identify case definitions of ARFAs, along with their sociodemographic and other characteristics, it was not anticipated that a quantitative approach to data synthesis would be required such as meta-analysis or pooling of results. Instead, a narrative approach to data synthesis was taken, considering the strength of evidence and consistency of findings across studies before drawing conclusions.

2.3.6 Replicated search

The selection of abstracts for inclusion was checked by an independent second reviewer (another PhD student in the department). The second reviewer was blind to the decisions whether to include or exclude made by the study author, and assessed the abstracts of all the papers retrieved by the search strategy. There was 100% agreement between the two reviewers as to which papers to include in the review.

2.4 Search results

A total of 445 papers were retrieved by the search strategy across all databases. Snowballing of references identified a further 2 papers. See figure 5 below.

The Cochrane library was searched for any recent or pending systematic reviews on ARFAs: no papers were found.

2.4.1 Exclusions

Out of the total 445 papers initially identified for inclusion, after screening of abstracts, 401 studies were excluded from the systematic review. The full text of 44 studies were reviewed, and a further 2 papers identified through snowball references. Thirty six of the full paper articles were excluded, leaving 10 papers for inclusion in the synthesis. Reasons for exclusion of papers were:

- some studies only described frequent attenders rather than alcohol-frequent attenders; one study excluded patients who had missed any hospital appointments (this is likely to exclude a lot of ARFAs);
- ARFAs were the main subject of the study but the study did not investigate their characteristics;
- one paper was a review rather than primary research.

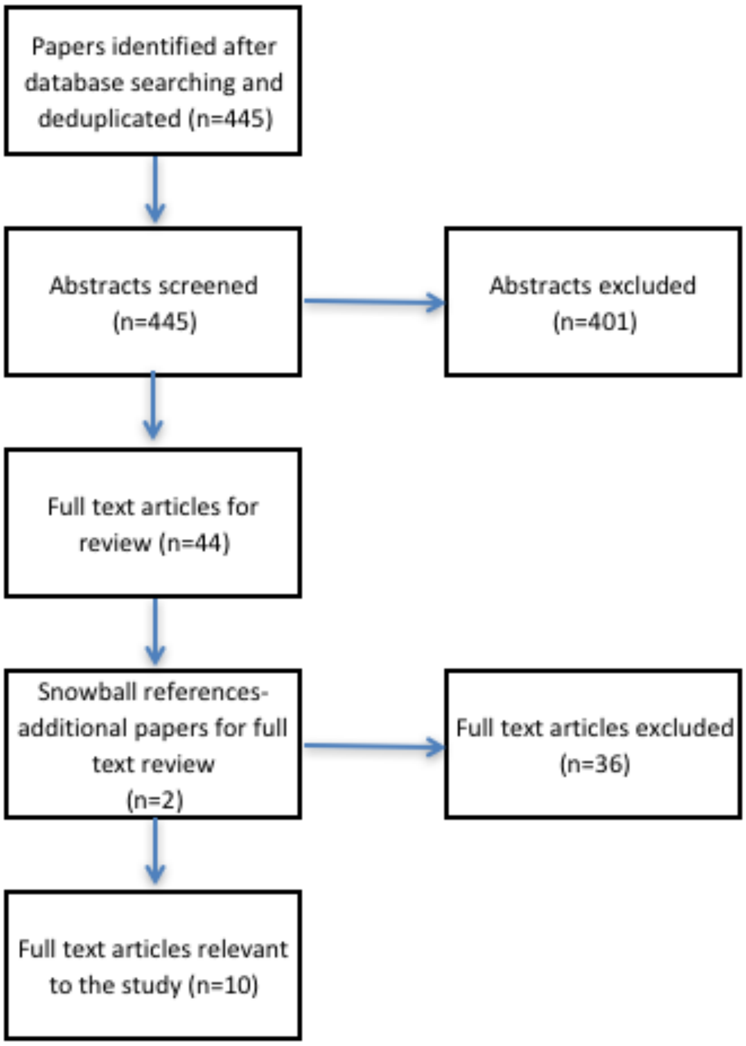

Figure 5: PRISMA (Moher, 2009) flow diagram of literature review results

2.5 Findings

No systematic reviews, meta-analyses or randomised controlled trials directly comparing the characteristics of ARFAs with other frequent attenders were found. No papers included the term “alcohol related frequent attenders” within the title.

10 papers related directly to frequent/recurrent alcohol –attendances, –admissions or -readmissions and were selected for full review (Booth et al, 1991; Baune et al, 2005; Fagan et al, 2014; Holland and Evenson, 1984; Lekharaju et al, 2014; McCormack, Goldfrank and Rotrosen, 2014; Ponzer, Johansson and Bergman, 2002; Siegel, Alexander and Lin, 1984; Slater and Linn, 1982; Rosenblatt and Mayer, 1974). Papers included in the review are summarised in table 4 along with appraisal comments.

One study was qualitative (McCormack, 2014). The majority of other studies were cross-sectional analyses of cohorts, mostly retrospective, using electronic patient record interrogation or case note review. Most studies had readmission rates as their primary outcome. No papers investigated the natural history of ARFAs.

One study used Hospital Episodes Statistics (HES) data to look at the burden of ARFAs in inpatients and A&E, however there was paucity of detail as it was only published in conference abstract form (Lekharaju et al, 2014).

Definitions of ARFAs

In addition to “circulating alcoholic” and “frequent attender”, nomenclature includes “revolving door” (Rabinowitz et al, 1995), “high impact users” (Bottle, Aylin and Majeed, 2006), ”frequent flyer”(Rosenblatt and Mayer, 1974), and phrases incorporating “readmission” of/and “alcoholics” (Booth et al, 1991; Slater and Linn, 1982; ISD Scotland, 2015). Links have also been made to terms such as “recidivist” (Labbate and Doyle, 1997; Larson et al, 2012; Slater and Linn, 1982). Most of these labels have negative or stigmatizing connotations. More recently the term “super-utilizer” has been used, mostly in commentary originating from the United States (Gawande, 2011).

The literature reveals various measures for a frequent attender:

- Four or more admissions with less than 2.5 years between consecutive admissions (for psychiatric admissions) (Rabinowitz et al, 1995).
- For ‘High-impact users’, no less than two further emergency hospital admissions in the 12 months following the start date of the index emergency admission Bottle, Aylin and Majeed, 2006).
- Admitted more than 3 times in 3 years (Kent and Yellowlees, 1994).
- 10 or more attendances in a twelve month period or 5 or more attendances in a three month period as defined by the NHS in Scotland (ISD Scotland, 2015).
- The College of Emergency Medicine’s best practice guideline (Royal College of Emergency Medicine, 2014) further differentiates between frequent and ‘very’ frequent attenders.
- or more attendances in 12 months (Locker et al, 2007).

Twenty-one hospitals in England run programmes for ARFAs (PHE, 2014), with no common method of identifying patients for treatment. This makes synthesis of results across studies more challenging.

What are the socio-demographic and other characteristics of ARFAs?
Five studies examined characteristics of people frequently attending A&E departments and in one case a psychiatric hospital due to alcohol. ARFAs are more likely to be male, homeless, aged between 31-50 (Baune et al, 2005). ARFAs with liver disease had longer lengths of stay, more unplanned readmissions and higher death rates (Lekharaju et al, 2014).

Baune et al (2005) undertook a 6-month assessment to profile the alcohol-related clinical burden at emergency rooms in 11 acute care hospitals of an urban area in Germany. Based on the findings from 2,372 attendances of 1,748 patients with symptoms of alcohol withdrawal/consumption, patients aged between 31-50 years, patients with no-fixed abode and males were significantly more likely to present multiple times than younger or older patients (χ^2:

p<0.05). Analysis of the study population versus local population suggests selection bias with under-representation of older and younger age groups. Characteristics of ARFAs were not compared to a control group.

Lekharaju et al (2014) used HES data to identify ARFAs and calculate the burden of ARFAs on an A&E department, however this was only published in conference abstract form. The methods used successfully identified ARFAs but there was no control/comparator group and no details of statistical analysis are given so it is difficult to weight the evidence. Given that the study included hospital data for an entire population (England) there are no concerns about selection bias or insufficient power. The study found that those with 5 or more admissions in 2 years and a diagnosis of liver disease had significantly longer lengths of stay and higher mortality risk (consistent with end-stage organ damage and “unavoidable” admissions).

A case series (Rosenblatt and Mayer, 1974) of 805 consecutive male admissions treated for alcoholism in a public psychiatric hospital examined marital status as a characteristic of those with readmissions and found that there were no significant differences between marital status for first and multiple admissions at any age. However, ARFAs were not the main subject of the study.

Physical and mental health co-morbidities are common amongst ARFAs. A small case series investigated the burden of one particular group of ARFAs: 41 patients requiring paracentesis for ascites due to cirrhosis (Fagan et al, 2014). Patients with early unplanned readmissions (within 1 month of previous readmission) experienced more hospital admissions, with longer hospital stays, compared to those without early unplanned readmissions. For this group of patients, age, gender, being Caucasian, cause and degree of cirrhosis and co-morbidities were not significantly associated with readmission. This was a small non-controlled study relating to a particular sub-group of ARFAs and the results are therefore not necessarily generalisable to the wider ARFA group.

The link between homelessness and frequent use of health services is established (Institute of Medicine, 1988; Lekharaju et al, 2014). A qualitative study of 20 homeless alcohol dependent adults with more than 4 emergency department visits in New York (McCormack et al, 2013) revealed a predominance of males among the group with a mean age of 46.5 years. Patients included in the study were self-selecting and recruited from a single hospital, however given that this was a qualitative study, generalisability of results was not necessarily the primary aim of the study. Other studies have found ARFAs to have a lower level of homelessness compared to most frequent ED users (Hughes et al, 2013).

How do the characteristics of ARFAs differ from non-alcohol-related frequent attenders and alcohol-related-non-frequent attenders?

The search retrieved no papers directly comparing the characteristics of ARFAs to those of non-alcohol related frequent attenders or alcohol-related non-frequent attenders.

Do any factors predict whether a person will become a frequent attender or an ARFA?

Five studies identified the following factors as predictors for readmission: younger age of onset of first problem drinking, source of referral to alcohol treatment, greater number of arrests due to alcohol, marriage breakdown (Holland and Evenson, 1984); drinking patterns and behaviours and ability to return to work (Fagan et al, 2014; Ponzer, Johansson and Bergman, 2002); biochemical markers (Ponzer, Johansson and Bergman, 2002); established chronicity, younger age, living alone (Siegel, Alexander and Lin, 1984); psychiatric co-morbidity, less stable family background and unemployment (Slater and Linn, 1982). No papers directly compared ARFAs with frequent attenders.

Holland and Evenson (1984) analysed 1192 first admissions to alcohol treatment in a cohort of alcoholics to predict readmission. Holland and Evenson (1984) identified 5 characteristics most likely to predict readmission which were: referral source (to alcohol treatment) other than self or friend; admission to a particular treatment site; spouse leaving; younger age at which drinking was first a problem and greater number of arrests due to drinking. The researchers were best able to predict patients who would not be readmitted as opposed to correctly predicting those who would have more than one readmission. This paper does not report whether the study population is representative of local geographic population or wider alcohol-drinking population. Little description is given about services that study participants were referred to or nature of the hospitals involved.

A prospective case series of 255 veterans seeking alcoholism treatment aimed to identify patient factors predicting early alcohol-related readmissions for alcoholics (Booth et al, 1991). Daily alcohol consumption, duration of heavy drinking, alcohol dependence, previous alcoholism treatment, sum of drinking behaviours and ability to adjust/return to work were all significantly associated with time to readmission. Veterans were self-selecting and it is unclear whether these veterans were representative of the wider population. No comparative analysis was performed.

A four-year follow-up study of 52 male alcoholics examining factors affecting the risk of readmission (Ponzer, Johansson and Bergman, 2002) identified 5 risk factors for readmission for alcohol detoxification including: heavy drinking before admission, a high gamma-glutamyltransferase level at admission, previous somatic care, and a sensation-seeking behavior in combination with a low platelet monoamine oxidase (MAO) activity level.

A longitudinal study of 325 alcoholics showed that established chronicity was associated with short time to readmission, as were youth and living alone. For first admissions, the receipt of aftercare was associated with a decreased likelihood of readmission (Siegel, Alexander and Lin, 1984).

Slater and Linn (1982) investigated predictors of rehospitalisation in 238 male alcoholics. Patients with more stable life histories in terms of employment and family background were less often readmitted. Being depressed, angry, inert and thoughtful (preoccupied) was associated with readmission.

2.6 Summary

These findings show that ARFAs typically have high levels of multimorbidity, including both physical and mental illness, social isolation, poor quality of life, unstable housing or homelessness, high criminal justice involvement, unemployment and lower socio-economic status (Kent and Yellowlees, 1994; McCormack, Goldfrank and Rotrosen, 2014; Skinner, Carter and Haxton, 2009; Mannix et al, 2014; Hughes et al, 2013; Schomerus et al, 2011). ARFAs tend to be older than alcohol-related non-frequent attenders (Smyth, 2011; McCormack et al, 2013) and racially diverse (McCormack, Goldfrank and Rotrosen, 2015). Notably, they either have poor or no engagement with existing specialist alcohol treatment services (Passetti et al, 2008). Qualitative research has also identified that ARFAs experience high levels of stigma and social exclusion (Schomerus et al, 2011).

One study looked at ARFAs using HES (Lekharaju et al, 2014) but did not investigate risk factors for readmission or predictors of becoming an ARFA. Whilst other studies use HES to look at risk factors for frequent emergency admissions (Bottle, Aylin and Majeed, 2006; Wu et al, 2016) ARFAs have not been examined as a specific subset.

This literature review suggests that my research which analyses the nature and characteristics of ARFAs using HES data will therefore be a novel addition to the current relatively small evidence base for this cohort.

Table 4: Summary of papers included in systematic literature review

Authors and publication year	Title	Participants, Setting and year	Type of study	Method	Primary outcome measure	Other outcome measure	Comments
Baune B.T. et al (2005)	A 6-months assessment of the alcohol-related clinical burden at emergency rooms (ERs) in 11 acute care hospitals of an urban area in Germany	1,748 patients with symptoms of alcohol consumption or withdrawal resulting in 2,372 attendances (3% of all medical admissions) Germany (2005)	Cross-sectional cohort study, 6 months data	Profile alcohol-related attendances to emergency rooms (ERs) of 11 hospitals, to assess risk factors associated with short-stay cases, repeat attendances and higher degree of alcohol consumption and to	OR (95% CI) for multiple attendances: Male vs female 1.95 (1.57-2.44); Older age: 21-44 yrs 13.3(1.8-96.5), 60-64 years 9.5 (1.2-73.6) vs =<20 years; clinical degree of alcohol consumption high 2.62 (1.84-3.72) middle 1.94 (1.35-2.77), low 1.77 (1.19-2.65) vs symptoms of withdrawal; Results of alcohol breath test >400 ml 2.30 (1.17-4.50), 201-400 ml 2.38 (1.79-	OR for duration of stay <24 hours (95% CI) Multiple attendance: 1.24 (1.04-1.49) vs single attendance; Clinical degree of alcohol consumption: high 9.39 (5.63-15.64), medium 5.47 (3.28-9.14) low 3.04 (1.73-5.35) vs withdrawal; Discharge mode: self 1.33 (0.97-1.81) vs medical; Alcohol diagnosis at ER: misuse 11.556 (7.67-17.43), dependence 2.81	Selection bias: study population not representative of local population (based on age)- under-representation of the <20 years and >65 years. Differences in male: female population in study compared to local population: over-representation of males, however probably reflects greater propensity for alcohol-related disease in males than females. Case records used from more than 1 hospital site, but different case mixes reported at different hospitals depending on

				estimate their impact on the alcohol-related burden at ERs.	3.18(, 101-200 1.70 (1.21-2.38) vs =<100. Patients aged between 31-50 years, patients with no-fixed abode and males were significantly more likely to present multiple times than younger or older patients (Chi ^{2} test: $p<0.05$)	(1.91-4.13) vs withdrawal; Diagnosis or suspicion of trauma: yes 3.4 (2.51-4.60) vs no. Males, patients below age <30 and >50 years, patients with no fixed abode and patients supported by social services were more likely to leave the hospital within 24 hours (Chi ^{2} test: $p<0.05$)	whether they were secondary or tertiary care centres and the medical specialties they included. 6 month duration of study could mean seasonal effects are included/excluded. Possible over-representation of alcohol-related attendances in this study compared to other studies.
Holland, R A, et al (1984)	Prediction of readmission in a cohort of alcoholics: a 2-year follow-up.	**1192 first admissions to alcohol treatment (mental health) programs, across 2 sites.** **Missouri, USA (1973-74)**	Cross-sectional cohort study, 2 years data	Database analysis including clinical data derived from assessment tools. Using demographic	Value of kappa (Cohen, 1960), which corrects for chance agreement, is only 0.46, indicating a modest level of prediction. 5 Predictor Items and Group Membership Mean Values (SD) 1. Referral source other than		Discriminate analysis does best in predicting those who do not get readmitted, with decreasing accuracy for higher attending groups, it seems likely that the predictor variables used do not include those most

				variables from the database, an analysis of variance was used to select the 80 items with the highest univariate F value across the readmission group classifications. These 80 items were then used in a stepwise discriminant analysis to determine predictors of readmissions.	self or friend: no readmission .21 (.41); 1 readmission .90 (.30); >1 readmission .93 (.26) 2. Admission to facility B: no readmission .25 (.43); 1 readmission; .20 (.40); >1 readmission .12 (.33) 3. Spouse going to leave 4. Drinking first a problem 5. No arrests or charges because of drinking: none .26 (.44); 1 arrest .34 (.48); >1 arrests .30 (.46) at age 20-29: no arrests .07 (.26); 1 arrest .18 (.38); >1 arrest .18 (.39) because of drinking: no arrests .09 (.28); 1 arrest .21 (.41); >1 arrest .25 (.44). The discriminant function was able to correctly predict 87% of the "no readmission" group, 67% of the "one readmission" group, and 21% of the "more than one readmission" group.		closely related to frequent attending. No calculations made to understand whether study population is representative of local geographic population or wider alcohol-drinking population. Little description about services that patients (study participants) have been referred to or nature of the hospitals involved.
Lekharaju P. et al (2014)	Emergency admissions for alcohol	Hospital Episode Statistics for all	Cross-sectional analyses of	Screening of all non-emergency	Mean age (sd): 49.5 yrs (16); males: 99,271 (71%);	Locally: 21,308 ARAs in 16,305 patients (2006-2012), with	Full paper not available-publication is a conference abstract only. Therefore

	related conditions: Making sense of routine data	English hospitals (2006-2008)- nationally: 219,158 ARAs in 139,077 patients; Inpatient coding data and AED attendances for 1 acute hospital Trust (2006-2013) England (June 2014)	routine coding data, with a focus on metrics related to 'frequent flyers' (FFs) Uncontrolled	episodes for alcohol-related codes at any position to flag Alcohol Related Attenders; linkage of individual cases to extract all admissions and order chronologically; allocation of each admission to a category based on primary and lower order diagnoses (flagging LIVER and NON-LIVER admissions); identification of frequent	Deprivation : Quintile 1 (most deprived) 36.4%, Quintile 5 (least): 9.4%; Co-morbidity (Charlson), 0.44 (0.68); LoS: 7 (14) days; Inpatient death: 6,656 (4.8%). No. admissions ranged from 1-60 per individual. Frequent Flyers: In two years, a cut-off of 5+ admissions identified 5,404 FFs (4% of patients; accounting for 18% of ARAs nationally) whereas 10+ identified 909 FFs (1% of patients; 6% of ARAs). Mean ARAs per Trust was 927 (range: 235-3930) with 6-fold variation in% of FFs (1.3% to 7.7%) and 4-fold variation in% with liver disease across	annual number of cases rising from 1,615 to 4,603. Defining FFs as 5+ ARAs per year, there were 320 FFs (2% of patients; 10% of ARAs). There was a year-on-year rise in ARAs (2,454-5,510) and AED attendances without admission (2,499-5,979). However, FFs (5+ admissions) declined from 64 to 47 between 2006 and 2012 and non-liver FFs from 25 to 12, suggesting a positive impact of new local services on multiple attenders, especially those lacking established liver disease.	very limited detail given about methodology employed, especially regarding cleaning the data, de-duplication, ICD-10 codes used to determine alcohol-related diagnosis. No “control” group comparisons eg non-alcohol related frequent attenders or alcohol-related-non-frequent attenders. Therefore % presented cannot be compared to other groups. Paper gives good overview of what data is potentially available within HES. No information regarding statistical analysis given. Deprivation data within HES relates to ward level not individual residence.

				flyers (FFs) based on various definitions of admission count; linkage of ARAs to all-cause AED attendances in local data; funnel-plot analyses of patterns across English Trusts; longitudinal trends in local data.	English hospitals (range: 7.6-30.2%). FFs coded with liver disease had significantly higher LoS and mortality risk consistent with end-stage organ damage and "unavoidable" admissions.		Mortality data included is for inpatient deaths only (recorded in HES) not for all deaths (recorded in ONS mortality statistics). Entire population dataset of hospital episode statistics included: therefore low risk of selection bias.
Ponzer, et al (2002)	A four-year follow-up study of male alcoholics: factors affecting the risk of readmission.	52 male alcoholics, followed-up for 4 years post inpatient detoxification	Case series Patients readmitted during study period were compared	Data from psychological and psychiatric baseline assessment tools supplemente d with	Identification of 5 risk factors for readmission for alcohol detoxification-heavy drinking before admission, a high gamma-glutamyltransferase level at admission,	The second year after admission seemed to be the most critical time for readmission.	Treatment fidelity: all patients received treatment according to the same detoxification protocol.

		(November 1991-June 1992)	to those not readmitted	register data on 4 years before and 4 years after detoxification admission	previous somatic care, and a sensation-seeking behavior in combination with a low platelet MAO activity level (odds ratios ranging from 4.2 to 10.2).		
Booth, et al (1991)	Patient factors predicting early alcohol-related readmissions for alcoholics: role of alcoholism severity and psychiatric co-morbidity.	255 veteran seeking alcoholism treatment who were consecutively admitted, treated and discharged from a Midwestern rural medical centre. USA (January-September 1983)	Prospective case series	Data from clinical and psychological baseline tools, supplemented with readmissions data recorded in a data file. Survival function (probability of not being readmitted) was estimated using the Kaplan-	To identify whether psychiatric co-morbidity was associated with the rate and time of alcohol-related inpatient admissions Scores on the Hamilton depression scale, history of polysusbstance abuse, diagnosis of antisocial personality did not affect time to readmission. No socio-demographic or psychological variables seemed to be strongly associated	38.4% were readmitted at least once for an alcohol-related primary diagnosis within 15 months. Range of time to readmission was 2-434 days. Median 132 days.	Treatment fidelity: each subject undertook a structured interview. Only looked for alcohol-related primary diagnoses. For longitudinal studies survival analysis can provide different and potentially more useful results than other analyses of dichotomous variables such as logistic regression or discriminant function analysis. Veterans were self-selecting in their desire to access alcoholism treatment. Unclear

				Meier method. Cox's proportional hazards regression, to investigate whether psychiatric comorbiditie s were significant risk factors for readmission	with survival time, with the exception of "adjustment to work". This is even after controlling for the effects of variables measuring the degree of alcohol dependence and chronicity. Daily alcohol consumption (ml ethanol) p=0.0001, duration of heavy drinking (years) p=0.0004, Sum of DSM-III criteria for alcohol dependence p=0.0022, Sum of DSM-III criteria for pathologic use of alcohol p= 0.0001, Previous alcoholism treatment p=0.0002, Sum of drinking behaviours p=0.0009		whether these veterans are representative of the wider population- no comparison done. 30% of subjects were undergoing treatment for the first time: may effect likelihood of success (70% attending for multiple times- less likely to succeed/shorter time to readmission).

					Work adjustment report p=0.0037 all significantly associated with time to readmission.		
Rosenblatt et al (1974)	Marital status and multiple psychiatric admissions for alcoholism: a cross-validation	805 consecutive male admissions treated for alcoholism in a public psychiatric hospital New York, July-December 1966	Case series	Re-analysis of data reported by Vallance* on the marital status of hospitalized alcoholics according to the categories first versus multiple admissions.	54.2% first admissions 33.5% first admissions were married vs 24.1% readmissions; 20.2% first admissions separated vs 29.0% readmissions; 34.9% first admissions single vs 36.6% readmissions; 3.0% first admissions divorced vs 3.5% readmissions; 4.1% first admissions widowed vs 3.3% readmissions. There were no significant differences between first and multiple admissions at any age.	The effect of race on the relationship between admission and marital status: in whites, significant differences between single and multiple admissions groups with respect to marital status at age 35-44 only, when there are more divorced (14%) and separated (28%) in the multiple admission group. The relationship between disrupted marriage and multiple admission is characteristic of black patients at an earlier age (25-34)	*Vallance,M. Alcoholism: a two-year follow-up study of patients admitted to the psychiatric department of a general hospital. Br. J. Psychiat. 111: 348-356, 1965. *Acccording to Vallance, among first admissions 62% were married, 21% separated, widowed or divorced. Multiple admissions 47% married, 38% separated, widowed or divorced. Differences between groups not significant.* Little detail of methods given. Primary hypothesis is set out but proposal to undertake ethnicity analysis not discussed until results.

						but of whites at a later age (45-54).	Results of statistical analysis are not presented. No detail given of participants. No assessment made to see how representative of the wider population they are.
Fagan et al (2014)	Burden of decompensated cirrhosis and ascites on hospital services in a tertiary care facility: time for change?	41 patients requiring paracentesis for ascites due to cirrhosis, between Oct 2011 and Oct 2012. Brisbane, Australia	Retrospective case review of notes and clinical database.	Early unplanned readmissions were defined as occurring within 1 month of previous admission. This was an uncontrolled study. Statistical analysis was by Mann-whitney test: early unplanned	Mortality: more patients died ($p=0.0008$) and/or developed spontaneous bacterial peritonitis ($p=0.027$) if they had an early unplanned readmission during the study period. Patients with early unplanned readmissions experienced more hospital admissions, with longer hospital stays, compared to those without early	Markers associated with readmission: Markers of liver disease Haemoglobin ($p=0.029$) Haematocrit ($p=0.024$) Hepatic encephalopathy ($p=0.037$) Previous heavy alcohol use ($p=0.021$) at index admission were associated with early unplanned readmission.	Small study Non-controlled Relates to a specific group of alcohol patients rather than more general ARFAs. Subgroup analysis of differences between socio-demographics of early unplanned readmissions vs no early unplanned readmission groups showed significant differences in previous heavy alcohol use and hepatic encephalopathy, therefore could be some selection bias.

				readmission vs. no early unplanned readmission.	unplanned readmissions.	Non-significant association with readmission: Age (p=0.47) Gender (p=0.2) Caucasion (p=1) Aetiology of cirrhosis (p=0.21) Diabetes (p=0.066) Metabolic risk factors (p=1) Chronic airways disease (p=0.62) Depression (p=0.3) Gastro-oesophageal varices (p=0.28) Charlson co-morbidity index (p=0.36) Cirrhosis specific scoring system (CirCom) (p=0.76)	
McCormack et al (2015)	Voices of homeless alcoholics who frequent Bellevue hospital: a	20 chronically homeless, alcohol dependent adults with more than 4 ED	Qualitative: detailed, semi-structured interviews using a	An administrative database and purposive sampling was	The primary research question was, how do individuals identifying as homeless alcoholics describe their lives?	The participants' perspectives support a multifactorial process for the evolution of their alcoholism and its	Small study but appropriate method: the phenomenolgical approach typically involves fewer than 25 people.

	qualitative study	visits for 2 consecutive years at Bellevue Hospital New York City,	phenomeno logical approach	used to obtain typical and atypical cases with diverse backgrounds.	4 broad themes emerged: alcoholism, homelessness, health care, the future. All 20 subjects began drinking as children or adolescents and reported becoming dependent shortly thereafter.	bidirectional reinforcing relationship with homelessness. Their self-efficacy and motivation for treatment is eroded by their progressive sense of hopelessness, which provides context for behaviors that reinforce stigma.	Recruited from a single hospital: may not be applicable elsewhere. Patients had to be willing to participate: selection bias. Social desirability bias may have been introduced in face-to-face interviews (telling the interviewer what they want to hear).
Siegel et al (1984)	Severe Alcoholism in the Mental health Sector II. Effects of Service Utilization Health Sector: on Readmission	Cohort of 325 alcoholics followed up for 2 years after index admission. 72% male.	Longitudinal cohort study	Cox proportional hazards model - “time to first subsequent readmission from discharge”. With multivariate analysis of demographic and service variables.	Established chronicity was associated with short "survival" in the community, as were youth and living alone For first admissions, the receipt of aftercare was associated with a decreased likelihood of readmission, especially in conjunction	The transition from inpatient to aftercare services was identified as a crucial point in treatment. Aftercare patients who did not receive services beyond 6 months in the community were likely to be readmitted, suggesting that this	Methodology is similar to life table analysis “to avoid the problems of cross sectional analysis” and allows for the handling of patients lost to follow-up without having to label them as treatment successes or failures.

					with inpatient stays of treatment that included rehabilitation services	period is also an important focus for treatment planning.	
Slater et al **(1982)**	Predictors of re-hospitalization in a male alcoholic population 1982-83	238 alcoholic patients admitted to inpatient substance misuse unit in Veterans Administration Medical Centre over a 2 year period and were followed up for 6 months after discharge	Longitudinal cohort study	Background and demographic histories were recorded using a 90 item questionnaire including drinking habits, race, age, education, marital status, and family, legal and employment histories. Standard analysis of variance	Thirty percent of the patients were readmitted within 6 months. Patients with more stable life histories in terms of employment and family background were less often readmitted. Being depressed, angry, inert, and thoughtful (preoccupied) was associated with relapse.	In addition, patients who had a low need to succeed at the time of admission were less prone to remain in the community. Perception of the treatment ward as more autonomous was related to longer community tenure. Whether or not treatment was completed was not associated significantly with readmission.	Veterans were self-selecting in their desire to access alcoholism treatment. Unclear whether these veterans are representative of the wider population. All subjects were male: may not be representative of general hospital populations.

				comparing those with readmissions to those without readmissions.			

3 Methods

3.1 Background

Hospital episode statistics (HES) is a data warehouse containing details of all admissions, outpatient appointments and A&E attendances at NHS hospitals in England. This data is collected during a patient's time in hospital and submitted to allow hospitals to be paid for the care they deliver. All NHS Trusts in England (including acute hospitals, primary care trusts and mental health trusts) are mandated to report activity on HES to NHS Digital. Subject to obtaining necessary approvals, this database can be used for research purposes. HES is stored as a large collection of separate records by NHS Digital- one for each period of care for each patient.

The England national HES dataset provides information on all inpatient admissions to NHS hospitals in England for the 5 years included in the studies. The dataset is rich with details of not just primary presenting problem but up to 19 additional secondary diagnoses coded from a single dictionary (ICD10), procedures underwent, lengths of stay, nature and location of care, sociodemographic data and discharge data. The dataset is very complete because it is the dataset used to calculate payments to hospitals for the care they have delivered: it is therefore in the interests of hospitals to complete the data accurately and return it to NHS Digital for collation. Not only is the data likely to be very complete for all NHS admissions, since only 11% of the UK population are estimated to have some form of private health cover (Kingsfund, 2014), and of those who have it only a very limited number will have comprehensive enough insurance to cover them for emergency admissions and chronic illness, it is likely that almost all of the admissions to hospital both private and NHS for ARFAs, especially those of an emergency nature and those for ARLD, are included within the HES inpatient dataset.

The studies in this thesis use pseudonymised data from the inpatient HES databases. Each line of data within HES represents an episode of care with a unique identifier for each individual patient called the encrypted HES patient ID (HESID). The HESID provides a way of tracking patients through the HES database (across years and between settings eg inpatient versus outpatient) without identifying them. HESID has two main advantages over other patient identifiers (eg NHS number):

- HESID is derived from several different patient identifiers, so more resilient to data quality/coverage problems affecting individual fields;
- HESID is a pseudonym field generated in HES processing so minimises the risk of patient identification and therefore minimises risk of data protection breaches.

3.2 Research permissions and sponsorship

The study uses pseudonymised annual data from the England national HES database from years 2011/12-2015/16 obtained through NHS Digital data access request service (DARS), accessed by South London and the Maudsley NHS Trust. South London and the Maudsley NHS Trust was data controller and sole data processing site. Sponsorship for the study was provided by King's College London Research and Development Office (IRAS no 199295).

3.3 Data quality

Each year NHS Digital comments on the quality of data available within HES. Poor quality data includes duplicate records, unmapped care records (where no code for the provider of the care is given), dates that are outside of possible date ranges and episodes of care which are unfinished within the year (these are repeated in the subsequent year). NHS Digital "cleans" the data provided by hospitals by removing records which are of poor quality, before making the remaining records available for extraction as HES. The content and format of data quality reports changed during the period 2011-2016, but an overview of the data quality reported by NHS Digital (formerly known as Health and Social Care Information Centre -HSCIC, and prior to that the NHS Information Centre) is provided in table 5 below. The table demonstrates the comprehensiveness of the HES data even after removal of poor quality data, with the dataset remaining 99.8-100% complete.

Table 5: Summary of HES data quality, 2011/12-2015/16

HES data year	Number of records included in the data (finished consultant episodes)	Number of invalid/missing records	% records retained after data cleaning
2011/12	17.5m	35,740	99.8
2012/13	17.7m	14,310	99.9
2013/14	18.2m	6,802	99.9
2014/15	18.7m	2,676	99.9
2015/16	19.2m	3,164	99.9

Source: NHS Information Centre, 2011; HSCIC, 2013; HSCIC, 2015b; HSCIC,2015c; NHS Digital, 2016

3.4 Data structure

The structure of HES inpatient records is based on financial years. Each row within each financial year represents a “finished consultant episode (FCE)” which is a continuous period of care under one consultant between an episode start date and an episode end date. If the episode starts and finishes within the same financial year it is classified as finished in that year. If the episode starts in one financial year but finishes in a later financial year, it will appear in both years of data, but it is classified as unfinished in the first year and finished in the later year. The data also contains details of up to 20 diagnoses made during the admission, details of operations and procedures during the admission, mode of admission, mode and place of discharge, patient’s personal identifiers such as date of birth, address, postcode. The data can be pseudonymised by NHS Digital prior to analysis, where date of birth is removed and age on admission substituted; address removed; partial postcode remains; and a pseudonymised individual identifier used so that patients can be tracked across years during analysis by a means other than using their name.

3.5 Data cleaning

As described in the data quality section above (section 3.3) NHS Digital removes poor quality hospital data from the inpatient dataset before making the data available for extraction as HES. Despite this initial cleaning process, some poor quality care records (for the same reasons as described in section 3.3- duplicates, unmapped provider codes, invalid dates or unfinished episodes) remain in the dataset and these were removed manually before commencing analysis. The following sections describe this second phase of data cleaning in more detail.

3.5.1 Removal of poorly coded observations

Poorly coded (missing) observations for the unique patient identifier (encrypted HESID), episode start date and episode duration were dropped from the dataset. For the purposes of this analysis, where one of these three variables was missing the entire line (FCE) of data was dropped from the dataset. Erroneous episode start, episode end, admission and discharge dates were checked and removed from the dataset, for example, an incorrect discharge year eg 1804, or a discharge date after the end of the 2015/16 year for the dataset. To do this a new date variable for each existing date variable was created, and parameters of valid dates set for the new date variables: 01/01/1930 - 31/03/2016.

3.5.2 Removal of duplicate records

Duplicates were identified within the dataset using a “transit” variable, created using a method designed by York University (York, 2015). The *transit* variable is created *de novo* using three existing collapsed variables within the dataset: source of admission, admission method and discharge destination, resulting in three possible categories for *transit*. The newly created *transit* variable is then used in conjunction with the unique patient identifier encrypted HESID, episode order, episode start and episode end dates to identify duplicate records. Any FCEs matching on all these variables, are identified as duplicates and dropped from the dataset, using the command *drop*.

3.6 Data management

The HES data is structured in such a way that it can be analysed using a number of different denominators: by patient, by finished consultant episode (FCE), by spell or by continuous inpatient spell. Each of these is defined below:

- Patient: all lines of data belonging to one patient (i.e. having the same unique patient identifier) are grouped together.
- Finished consultant episode (FCE) – an inpatient or day case episode where the patient has completed a period of care under a consultant and is either transferred to another consultant or discharged.
- Spell- a continuous period of time spent as an inpatient in one hospital following admission, which may include one or more episodes of care.
- Continuous inpatient spell (CIPS)- a continuous period of time spent as an inpatient in one or more hospitals following admission, which may include one or more episodes of care.

Prior to identifying patients, FCEs, spells and CIPS, all lines of data (FCEs) were sorted chronologically by unique patient identifier, episode start and end date, order of the episode (an existing variable within HES which attaches a list order to each finished consultant episode within an admission) using the command *sort*.

3.6.1 Identifying all records associated with each patient

Following the chronological sorting method described above, all FCEs belonging to each patient appear as consecutive lines of data, where they share the same unique patient identifier.

3.6.2 Identifying spells

The Information Centre method 4 (York, 2015) was deployed to identify spells within the dataset, as defined in section 3.6 above. A spell is created by matching FCEs by unique patient identifier, admission date and provider code. As the FCEs are arranged chronologically, if the subsequent FCE matches the previous one across these three variables they are deemed to be a part of the same spell. Spells are then numbered in chronological order using the *group* function.

3.6.3 Identifying continuous inpatient spells

Continuous inpatient spells (as defined in section 3.6 above) were identified using methodology created by National Centre for Health Outcomes (NCHOD, 2009). Having arranged the dataset in chronological order of FCE by unique patient identifier, a CIPS is identified when the following criteria are satisfied:

- two consecutive FCEs belong to the same spell (using identifying spells methodology outlined in section 3.6.2 above) or two consecutive FCEs have the same unique patient identifier; and
- there is less than 2 days between the end of the previous FCE and start of the next FCE; and
- the discharge destination for the previous FCE is to another inpatient setting (which can include other providers); or
- the patient was recorded as being admitted from another inpatient setting; or
- the mode of admission for the patient's FCE was recorded as being from another hospital provider.

CIPS are then numbered in chronological order using the *group* function.

3.6.4 Identifying alcohol related episodes

The presence of a wholly attributable alcohol related diagnosis as defined by ICD 10 classification (WHO, 2016) within any of the 20 diagnostic fields in the HES data results in the FCE being regarded as an “alcohol-related FCE”. There are 34 ICD 10 diagnostic codes which are considered to be wholly attributable to alcohol (Jones and Bellis, 2013). These are shown in table 6 below.

Table 6: List of wholly attributable alcohol diagnoses and their corresponding ICD10 code

ICD10 code	Wholly attributable alcohol diagnosis
F100	acute intoxication
F101	harmful use
F102	dependency syndrome
F103	withdrawal state
F104	withdrawal state delirium
F105	psychotic disorder
F106	amnesic syndrome
F107	residual and late-onset psychotic disorder
F108	other mental and bahaviour disorders due to alcohol
F109	unspecified mental and behaviour disorders due to alcohol
K700	alcoholic fatty liver
K701	alcoholic hepatitis
K702	alcoholic fibrosis and sclerosis of the liver
K703	alcoholic cirrhosis of the liver
K704	alcoholic hepatic failure
K709	alcoholic liver disease, unspecified
T510	toxic effect of ethanol
T511	toxic effect of methanol
T519	toxic effect of alcohol, unspecified
E244	alcohol-induced pseudo-Cushing's syndrome
G312	degeneration of nervous system due to alcohol
G621	alcoholic polyneuropathy
G721	alcoholic myopathy
I426	alcoholic cardiomyopathy
K292	alcoholic gastritis
K852	alcohol-induced acute pancreatitis
K860	chronic pancreatitis (alcohol induced)
Q860	fetal alcohol syndrome (dysmorphic)
R780	Excess alcohol blood levels
X45	accidental poisoning by and exposure to alcohol
X65	Intentional self-poisoning by and exposure to alcohol
Y15	Poisoning by and exposure to alcohol, undetermined intent
Y90	Evidence of alcohol involvement determined by blood alcohol level
Y91	Evidence of alcohol involvement determined by level of intoxication

Coding of HES data can include up to 20 diagnostic codes which as well as being listed individually, are summarised within one concatenated diagnostic field within the dataset. In order to identify specific diagnoses within this one concatenated field, a search was undertaken for each diagnosis within the concatenated diagnostic field using the *regexm* command. By searching for all 34 wholly attributable alcohol diagnostic codes in this way all alcohol diagnoses can be captured rather than just those featuring in the primary or secondary diagnosis fields (which are included as separate variables within the HES dataset).

The following section describes the process of categorising FCEs, spells and CIPS on the basis of whether they were alcohol-related i.e. included a wholly attributable alcohol-related diagnosis or not.

3.6.5 Identifying patients with alcohol-related episodes

FCEs were sorted by unique patient identifier and chronologically so that all FCEs relating to each individual patient were grouped together. Closer inspection of the data revealed that not every line of data included the same diagnostic codes even in the presence of a long-term condition, within the same spell or CIPS. For example, a code of chronic obstructive pulmonary disease may have been recorded as a diagnosis within the first FCE for a particular spell, but that did not mean it was then subsequently recorded for all FCEs within the same spell, even though the condition by nature of its chronicity would have been present throughout. This may reflect differing views on diagnosis amongst clinicians or difference in opinion amongst coders. Either way, it presents an analytical challenge. To overcome this in relation to ascertaining whether a person had an alcohol-related episode or not at any point during the 2013/14 year, all FCEs for each patient were searched for each alcohol diagnosis and a summary variable was created which coded the first line of data for each patient if any of the FCEs for that patient contained an alcohol-related diagnosis. This facilitated the grouping of patients by overarching presence of alcohol-diagnosis or not, without double-counting.

3.6.6 Identifying alcohol-related continuous inpatient spells

An alcohol-related CIPS (as defined in section 3.6.3 above) is a CIPS within which a wholly attributable alcohol-related diagnosis is recorded. In order to identify alcohol-related CIPS, the data was first grouped in to spells then CIPS as described in sections 3.6.2 and 3.6.3 above. Then a summary variable was created to denote the presence of an alcohol-related FCE within the CIPS. This method ensured that wholly-attributable alcohol diagnoses from all 20 HES diagnostic fields were included, and from every line of data within the CIPS. The summary variable recorded a 1 against the first line of data for each CIPS if any of the FCEs within each CIPS for that patient contained an alcohol-related diagnosis or a 0 if not. This facilitated the grouping of CIPS by overarching presence of alcohol-related diagnosis or not, without double-counting.

3.6.7 Identifying patients who are frequently admitted to hospital

As previously discussed a person who attends or is admitted to hospital more than three times during a year is defined as a "frequent attender" in this study. For the purposes of this analysis, an attendance or admission is counted if it registers as a CIPS i.e. involves an inpatient stay (which could be less than 24 hours long but is recorded as inpatient rather than a visit to an accident and emergency department, an outpatient department or even a prolonged assessment where no inpatient stay has occurred).

In order to identify patients who have had 3 or more CIPS during the year, the data was first sorted by unique patient identifier and then by FCEs chronologically. FCEs were grouped in to CIPS by patient using the methodology described in section 3.6.3 above. A new variable 'CIPS_tot' was then created which counted the total number of CIPS for each patient using the *total* command and recorded it next to the first FCE for each patient. A new variable to identify CIPS associated with patients who were non-frequent attenders (ie had fewer than 3 CIPS during the year) "*nFACIP*" was created. The variable *nFACIP* recorded a 1 next to the first FCE within a CIP for each patient if the patient had fewer than 3 CIPS per year and 0 if the patient had more than 3 CIPS per year. This facilitated the grouping of patients by whether they were frequent attenders or not and using the function *total* in combination with the 'CIPS_tot' variable, gave the corresponding total number of CIPS recorded for frequent and non-frequent attending patient groups.

Another new variable called '*freqatt*' was created, which allocated every FCE within the dataset to one of 2 patient groups, categorised and labelled as: '1' frequent attender, '0' non-frequent attender. To ensure consistency of labelling within CIPS, so that one FCE was not labelled as freqatt '1' whilst another FCE within the same CIPS '0'; all FCEs within the same CIPS for each patient were recorded as having the same status as the preceding FCE. This was justified because the total number of CIPS for each patient was recorded alongside the first FCE for each patient (as explained earlier in this section) so the status "frequent attender" or "non-frequent attender" is determined alongside the first FCE, triggering the remaining FCEs within that CIPS to adopt the same label, regardless of the content of the individual FCE.

3.6.8 Identifying alcohol-related frequent attenders and their corresponding total CIPS

Using *if*, *and*, *or* statements in combination with the newly created variables denoting whether a patient has had an alcohol-related FCE during the year (as described in section 3.6.5) and whether the person is a frequent attender (as set out in section 3.6.7 above) enabled patients within the dataset to be allocated to one of four distinct patient groups, defined below:

- Alcohol-related frequent attenders (ARFAs)

Any person with 3 or more admissions to hospital in the 12 month period in question, where at least one of the diagnoses/causes of admission (as defined by ICD-10 code) in any of the 20 diagnosis fields in HES was for a condition wholly attributed to alcohol (Jones, 2013).

- Non-alcohol-related frequent attenders (or frequent attenders, NAFAs)

Any person with 3 or more admissions to hospital in the 12 month period in question, and none of the diagnoses/causes of admission in any of the 20 diagnosis fields in HES was for a condition wholly attributed to alcohol.

- Alcohol-related, non-frequent attenders (alcohol related admissions, ARNFAs)

Any person who had 1 or 2 (but not 3 or more) admissions to hospital in the 12 month period in question, where at least one of the diagnoses/causes of admission in any of the 20 diagnosis fields in HES was for a condition wholly attributed to alcohol.

- Non-alcohol-related, non-frequent attenders (NANFAs)

Any person who had 1 or 2 admissions to hospital in the 12-month period in question, where none of the diagnoses/causes of admission in any of the 20 diagnosis fields in HES was for a condition wholly attributed to alcohol.

The total number of CIPS during the year for each of the four patient groups was counted. For ease and clarity, especially when undertaking more complex analyses than simple counts, a new variable called '*status*' was created, which allocated every FCE within the dataset to one of the 4 patient groups above, categorised and labelled as: '1' NANFA, '2' ARNFA, '3' NAFA and '4' ARFA. To ensure consistency of labelling within CIPS, so that one FCE was not labelled as ARFA whilst another FCE within the same CIPS labelled as NANFA; all FCEs within the same CIPS for each patient were recorded as having the same status as the preceding FCE. This was justified because the allocation of status category for each patient was recorded alongside the first FCE for each patient (as explained earlier in sections 3.6.5 and 3.6.7). The status "frequent attender" or "non-frequent attender" was determined alongside the first FCE, and triggered the remaining FCEs within that CIPS to adopt the same label, regardless of the content of the individual FCE.

In addition another variable was created, using similar methodology to creating the variable “status” but this time categorising patients in to 2 distinct groups: ARFA and all other non-ARFA patients so that comparisons colud be made across 2 groups.

3.6.9 Patient age

The 5-year HES dataset included the variable “*startage*” which listed the age of the patient in years at the start of each FCE. This variable was generated by NHS Digital. Some entries were miscoded and so prior to analysis, any missing or badly coded entries were dropped, by only keeping observations where the patient’s age was less than 129 years old at the start of the episode.

3.6.10 Patient gender

The 5-year HES dataset contained a pre-existing variable “sex” indicating the patient’s gender. Categories for the variable were labelled “1=male”, “2=female”, “9=not specified” and “0=unknown”. The variable was re-labelled gender.

3.6.11 Deprivation

The HES output contained a pre-existing variable containing the 2004 indices of deprivation score. The 2004 indices of deprivation score was developed by the Office for National Statistics based on the 2001 Census data. Seven domains of deprivation (income; employment; health and disability; education, skills and training; barriers to housing and services; living environment; and crime (see appendix for full details) are combined to produce an overall index of deprivation, each of which contains a number of component indicators.

The 2004 indices of deprivation contain data at the lower super output area (LSOA) level. LSOAs are smaller areas than wards and contain a minimum of 1000 people and 400 households. Within the HES output (and undertaken by

NHS Digital prior to making the data available to users), the LSOA level index of deprivation has been matched to each patient based on their postcode. However, whilst providing a smaller geographical area representation of deprivation than ward-level data, the index of deprivation is not a true measure of the individual's income or deprivation status but is used as a proxy in these studies.

The Income Deprivation Domain measures the proportion of the population in an area experiencing deprivation relating to low income. The definition of low income used includes both those people that are out-of-work, and those that are in work but who have low earnings (and who satisfy the respective means tests). A combined count of income deprived individuals per LSOA is calculated by summing the following six non-overlapping indicators:

- Adults and children in income-based Jobseeker's Allowance families;
- Adults and children in income-based Employment and Support Allowance Families;
- Adults and children in Pension Credit (Guarantee) families;
- Adults and children in Working Tax Credit and Child Tax Credit families not already counted, that is those who are not in receipt of Income Support, income-based Jobseeker's Allowance, income-based Employment and Support Allowance or Pension Credit (Guarantee) and whose equivalised income (excluding housing benefit) is below 60 per cent of the median before housing costs; and
- Asylum seekers in England in receipt of subsistence support, accommodation support, or both.

The overall indices of deprivation score for each LSOA are difficult to interpret. They are not scored on a continuous scale but areas are ranked in order of their score. The larger the score the more deprived the area (and the lower its rank). However, the income deprivation domain and the employment deprivation domains within the indices of deprivation 2004 are meaningful scores and relate to the proportion of the relevant population experiencing either income or employment deprivation. For example, an Income Deprivation Domain score of 0.25 for an LSOA means that 25% of the population in that LSOA are experiencing income deprivation.

Given that the income deprivation domain of the indices of deprivation provides a measure of the proportion of individuals within an LSOA experiencing income deprivation, this provides a useful way of comparing income deprivation between individuals (based on the area they live in) and can be used for analytical purposes. Therefore, only the income domain was used as the variable for deprivation measure. A more recent version of the Indices of Deprivation is available (2010) but this would need to be linked de novo to the hospital admissions extract by NHS Digital in order to use it.

3.6.12 Count of co-morbidities

A variable to capture the clinical complexity of patients within the HES dataset was created. Whilst pre-existing tools exist a simple count of the range of different conditions that people presented with was used.

In order to identify patients' co-morbid conditions in addition to their alcohol-related diagnosis (for admissions recognised as being alcohol-related according to the earlier definition provided) or for non-alcohol related admissions their presenting condition, a new variable was created recording a simple count of the number of additional conditions each person was diagnosed with on admission.

To calculate the total number of conditions for each individual, the concatenated diagnostic field containing 4 digit ICD10 codes from all 20 diagnostic HES fields was searched using the *regexm* command. The concatenated diagnostic field was searched for a list of diagnostic codes shown in table 7 below.

Table 7: Diagnostic groups and corresponding ICD10 codes included in the count of co-morbidities variable

Diagnostic groups included	**ICD10 codes included in the search**
Tuberculosis infection	A15-A19
Sexually transmitted infections	A50-A64
HIV	B20-B24
Any neoplasms linked to alcohol	C10, C15, C18, C20, C22, C25, C50
Nutritional anaemias	D50, D51, D52, D53
Diabetes mellitus	E10- E14
Malnutrition	E40-E46 and E50-E64
Mental health excluding alcohol diagnoses (F10-F19)	F00-F09, F20-F99
Nervous system disorders	G00-G99
Circulatory system disorders	I00-I99
Digestive disorders and liver disease excluding those relating to alcohol (K70, K86)	K00-K99
Dermatological conditions	L00-L99
Musculoskeletal conditions	M00-M99
Genito-urinary conditions	N00-N99
Respiratory disorders	J00-J99
Accidents	V00-V99
Self-harm	X60-X99
Assault	Y00-Y09

Not all diagnoses within the ICD10 coding system were used but diagnostic codes of the most common causes of morbidity and mortality in the UK (heart disease, cancers, respiratory disease, diabetes, musculo-skeletal disorders) were included in addition to codes for diseases associated with alcohol (mental health disorders, some cancers, digestive disorders, some neurological conditions, accidents, malnutrition, infections). ICD10 codes for conditions which are wholly attributable to alcohol were excluded from this list as they were used when categorising patients into ARFA and other groups.

Summary diagnostic variables were created to combine individual diagnostic codes within a group, for example, for diabetes mellitus, diagnostic variables were created for the ICD10 codes E10, E11, E12, E13, E14. If any of these diagnostic codes were present within the concatenated diagnostic field, a '1' would be recorded against the relevant summary variable.

The new *count* variable was created to provide an overall count of the number of different diagnostic groups from the list in table 7 that each patient presented with. The higher the count, the wider the range of presenting conditions (in addition to their alcohol-related diagnosis if relevant) the patient had on presentation. This is a somewhat crude measure of complexity and does not take in to account any clinical burden of illness associated with each individual or group of conditions.

3.7 Overview of data analysis

Using the cleaned HES data my thesis presents 5 empirical chapters based on two samples of patients (South London residents and a 5 year England national HES dataset). A description of the individual datasets and the analyses conducted in each chapter is provided in the following sections.

3.8 Study 1: Identifying the characteristics of alcohol-related frequent attenders

3.8.1 Sample

All hospital inpatient records for adult patients (aged over 18 years) living in South London (which includes the Boroughs Bexley, Bromley, Croydon, Greenwich, Kingston, Lambeth, Lewisham, Merton, Richmond, Southwark, Sutton and Wandsworth) who were treated in any English hospitals between 01/04/2013 and 31/03/2014 , whose hospital episode data has been captured, is complete and valid in NHS Digital’s admitted patient care database were included. Data pertaining to children (persons aged less than 18 years) and persons whose hospital episodes statistics data was incomplete or invalid were excluded from the analysis. The sample included records from 366,616 people and 696,156 admissions.

3.8.2 Counts of persons and admissions

Counts of persons by each of the four groups ARFA, ARNFA, NANFA, NAFA and their corresponding FCEs and admissions (CIPS) were made using methodological approaches described above and comparisons made and described across the four patient groups.

3.8.3 Single characteristics of ARFAs compared to other patient groups

An initial univariable analysis compared differences in age, total co-morbidities and deprivation (continuous variables) between the four patient groups (ARFAs, ARNFAs, NAFAs, NANFAs- see section 3.6.8 for definitions) using means and standard deviations, and frequencies and percentages for the categorical variable gender. ARFAs and controls were compared using one-way analysis of variance (ANOVA) for continuous variables (age, deprivation and count of co-morbidities) to test for statistical significance, and Chi-squared for the categorical variable, gender. A Bonferroni correction was carried out on the p-value for multiple testing.

3.8.4 Characteristics of alcohol-related frequent attenders

An analysis using a combination of variables age, gender, count of co-morbidities and income deprivation was undertaken to calculate an odds ratio for being an ARFA. A logistic regression including the variable 'alcohol-related frequent attender or not' as the dependent variable, and the independent variables: age at start of CIPS, gender, the proportion of the population in an area experiencing deprivation and number of co-morbidities on admission. The data were analysed in terms of persons rather than admissions (CIPS). The model tested the combined effects of age, gender, income deprivation and the number of co-morbidities present on admission (excluding wholly attributable alcohol diagnoses) as predictors for being an alcohol-related frequent attender. Tests for interactions between variables were performed. The interaction terms were then plotted on graphs.

3.8.5 Investigating factors which influence frequent hospital admissions for all causes

A logistic regression was conducted to investigate variations in effect size (odds ratios) on the dependent variable, frequent attender, in conjunction with the independent variables: age at start of admission, gender, the proportion of the population in an area experiencing deprivation relating to low income and number of co-morbidities.

Tests for interactions between variables were performed and the regression models refitted to include the interaction term. The interaction terms were then plotted on graphs.

3.8.6 Which demographic factors influence total hospital admissions for all causes?

A linear regression model was created to analyse the impact of various demographic factors (age, gender, deprivation, co-morbidities) on the total number of hospital admissions (all cause) in the year 2013/14. Any variables which were not normally distributed were transformed using natural log prior to running the model. A plot of the distribution of the transformed variable was created to check for normal distribution following transformation. Having run the linear regression model, residuals were plotted to test for heteroskedasticity.

3.8.7 Investigating factors which influence total number of alcohol related hospital admissions

A linear regression model was created to analyse the impact of various demographic factors (age, gender, deprivation, co-morbidities) on the total number of alcohol-related hospital admissions in the year 2013/14. Any variables which were not normally distributed were transformed using natural log prior to running the model. A plot of the distribution of the transformed variable was created to check for normal distribution following transformation.

Tests for interactions between variables were performed and the regression models refitted to include the interaction term. The interaction terms were then plotted on graphs.

Having run the linear regression model, residuals were plotted to test for heteroskedasticity.

3.9 Study 2: Are alcohol-related frequent attenders “complex” patients?

The study was case-control by design, comparing the health status of ARFAs with 3 other groups: non-frequent alcohol related attenders, frequent non-alcohol related attenders and non-frequent non-alcohol-related attenders at hospitals in South London. This research used electronic patient data from the national HES database.

The study examined the diagnosis codes, labelled according to ICD10 classification, within the 20 available diagnostic fields within the HES inpatient data. The first diagnostic fields contains the primary diagnosis, and all other fields contain subsidiary diagnoses up to a maximum of 20 codes including the primary diagnosis. Using this data, the study aimed to analyse and document:

1. Primary presenting diagnosis for each of the four patient groups;
2. Total number of alcohol related diagnoses by each of the four patient groups and by gender;
3. Comparison of mean number of co-morbidities by each of the four patient groups;
4. Assessment of co-morbidities for each patient group using a co-morbidity index;
5. Prevalence and relative risk of particular co-morbidities by each of the four patient groups; and
6. Prevalence of mental health diagnoses amongst the four patient groups.

The results of this analysis aimed to describe the relative complexity of ARFAs in terms of their diagnoses and co-morbidities, compared to other patient groups.

3.9.1 Sample

All hospital inpatient records for adult patients (aged over 18 years) living in South London (which includes the Boroughs Bexley, Bromley, Croydon, Greenwich, Kingston, Lambeth, Lewisham, Merton, Richmond, Southwark, Sutton and Wandsworth) who were treated in English hospitals between 01/04/2013 and 31/03/2014 , whose hospital episode data has been captured, is complete and valid in NHS Digital’s admitted patient care database were included. The sample included records from 366,616 people and 696,156 admissions.

3.9.2 Primary presenting diagnosis by patient group

Contents of the primary diagnostic field within each CIPS (admission) within the HES data for each patient was analysed and results summarised to show the most common presenting conditions for each of the four patient groups ARFAs, NANFAs, NAFAs and ARNFAs. For each condition the percentage of all CIPS accounted for by that condition for each of the four patient groups was calculated.

3.9.3 Total number of alcohol related diagnoses by each of the four patient groups and by gender

All diagnostic fields within HES were searched for wholly attributable alcohol diagnoses according to the list of ICD10 codes listed in table 7. A summary variable was then created to count the total number of unique wholly attributable alcohol diagnoses for each patient. Counts of unique wholly attributable alcohol diagnoses were summarised for each of the four patient groups.

3.9.4 Comparison of mean number of co-morbidities by each of the four patient groups

As described in section 3.6.12, the *count* variable was created to count the total number of different conditions that patients presented with on admission. For admissions recognised as being alcohol-related, co-morbid conditions were defined as all other diagnoses apart from their alcohol-related one; and for non-alcohol-related admissions, co-morbid conditions were all other conditions apart form their presenting condition).

3.9.5 Assessment of co-morbidities for each patient group using a comorbidity index

In addition to creating a simple count of comorbidities for each patient group as described above, a pre-existing weighted comorbidity index, known as the Charlson comorbidity index, was applied to the patient population.
The Charlson comorbidity index was originally developed as a prognostic taxonomy for comorbid conditions which singly or in combination can alter the short-term risk of mortality for patients enrolled in longitudinal studies, taking into account that comorbidities may be confounders. The taxonomy was developed using patient data from 604 patients admitted to a New York hospital in one month in 1984 (Charlson et al, 1987). The index was then used to predict the risk of death for 685 patients being treated for primary breast cancer in Yale between 1962 and 1969.

Simply counting the number of comorbidities assumes that each disease places the same burden on a patient, and carries the same risk of mortality. The Charlson index considers the type of disease (and allocates a weight accordingly) when predicting risk of mortality. Table 8 below shows the weights allocated to each of the co-morbidities within the Charlson index. Higher weights are allocated to conditions with greater short-term risk of mortality, thus a higher score on the Charlson Index indicates a greater risk of mortality in the short-term for the patient.

Table 8: Assignment of weights to comorbidities on the basis of disease type

Assigned weight	Disease
1	Myocardial infarct Congestive heart failure Peripheral vascular disease Cerebrovascular disease Dementia Chronic pulmonary disease Connective tissue disease Ulcer disease Mild liver disease Diabetes
2	Hemiplegia Moderate or severe renal disease Diabetes with end organ damage Any tumor Leukemia Lymphoma
3	Moderate or severe liver disease
6	Metastatic solid tumor AIDS

The Charlson weightings were applied to the 2013/14 South London dataset based on each patient's ICD10 diagnostic codes. Only the single diagnosis with the highest weighting (from the list in table 8 above) was allocated a weight. If a patient has none of the conditions listed in table 8 above, then the weighting assigned will be 0. The tool therefore gives an indication of the severity (and consequential disease burden) pertaining to the most "severe" of all the diagnoses present, but does not give an indication of the full range of conditions which may be present for each patient. This approach therefore offers a different angle on "complexity" compare to that described in section 3.9.4 above.

For each of the four patient groups, a weighted average score (total sum of weightings for each patient group divided by number of patients in each patient group) was calculated.

In addition, prevalence (rate of disease per 1000 peope) of each of the conditions included in the Charlson comorbidity index were calculated for each of the four patient groups.

3.9.6 Prevalence and relative risk of particular co-morbidities for ARFAs versus non-ARFAs

The prevalence of a selection of ICD10 coded diagnoses were examined amongst 2 groups: ARFAs and non-ARFAs (which included NAFAs, NANFAs and ARNFAs). Not all ICD10 coded diagnoses were analysed: only those of co-morbidities thought to be most relevant to an alcohol diagnoses were included. Comparison between absolute risk of the co-morbidity in question between ARFAs and non-ARFAs, using relative risk, and the strength of the significance of the relationship was tested using χ^2 .

3.9.7 Prevalence of mental health diagnoses amongst the four patient groups

Primary diagnostic codes were searched to identify patients who presented with mental health conditions. All mental health diagnoses from the ICD10 codebook were included in the search. For each of the four patient groups ARFAs, NANFAs, NAFAs and ARNFAs the number of patients with and without a mental health diagnoses were counted, along with the corresponding number of CIPS (admissions) by patient groups attributable to mental health conditions. The most common 16 mental health presenting conditions for ARFAs were identified.

3.10 Study 3: Predictors of alcohol related frequent attendance in England in 2015/16

A 5-year dataset including records of all adult persons admitted to hospital (Hospital Episode Statistics) in England between 1st April 2011 - 31st March 2016 was obtained from NHS Digital through the Data Access Request Service. The very large dataset was initially managed using Microsoft SQL Server Management Studio software, to undertake counts of total patients included within each year, allocate patients to one of four groups based on their alcohol and frequent attending status (using the definitions already described in this chapter) and select patient cohorts for further longitudinal analysis. Once sampling had taken place, data was transferred in to Stata MP v12.0 software for de-deduplication prior to analysis.

The total population in a given year included all patients with at least one finished consultant episode in the year that was part of an admission that started within the year. Alcohol attenders were selected using finished consultant episodes for admissions that started within year only e.g. for 2011/12 all episodes where admission date was between 01/04/2011 and 31/03/2012. As a result admissions that started in the previous year (before 01/04/2011) but spanning the year end in to 2011/12, along with admissions that did not finish within 2011/12 (where admission date was before 31/03/2012 but discharge date was after 31/03/2012 i.e. an unfinished episode) were excluded. Dropping unfinished episodes had a small impact overall on number of records included: 0.15% episodes per year dropped. In terms of quality of the dropped unfinished episodes, 75% of unfinished episodes in 2011 did not contain diagnoses or operation codes. Furthermore, there were discrepancies between the total number of unfinished episodes in 2011 reported in the 2011 and 2012 years. In summary, due to these discrepanices, it can be concluded that little was lost in data terms from a qualitative point of view by dropping these unfinished episodes.

To select frequent attenders, the number of distinct admissions that started during the year were counted regardless of when they ended and those patients with three or more distinct admissions (for any cause) starting within a year were labelled as frequent attenders.

For the longitudinal analysis, all episodes from all years' data were included in the dataset regardless of when they started or finished. Duplicate episodes which spanned two years (i.e. which started in one year and finished in the subsequent year) were filtered out so that only one record of each admission remained rather than 1 copy of the admission featuring in both years' data. Unfinished episodes in 2015/16 were also included in the dataset.

3.10.1 Missing data

Overall missing data for the 2015/16 cohort was estimated to be 6.0% so the data were analysed in their entirety with no corrections or estimations made to account for missing data.

3.10.2 Sampling for 2015/16 cohort

For the longitudinal analysis, a cohort of patients was selected from all adult patients aged 18 years or over who were treated in English hospitals between 01/04/2015 and 31/03/2016, whose hospital episode data had been captured, was complete and valid on NHS Digital's Hospital Episodes Statistics database. Records of admissions for the selected patients from the previous 4 years (01/04/2011-31/03/2015) were included. Patients were categorised in to each of the four groups based on alcohol and frequent attending status described in section 3.6.8 and are summarised in table 9 below.

Table 9: Categorisation of all patients admitted to hospital in England 2015/16 who were alcohol patients and/or frequent attenders

	Total number of patients admitted to hospital in 2015/16 in England	% patients within each of the 4 groups
ARFAs	54,369	0.71
ARNFAs	136,015	1.78
NAFAs	1,192,476	15.6
NANFAs	6,277,248	81.9
Total patients	7,660,108	100

The entire 2015/16 national admitted patient dataset was too large to analyse in Stata due to technical constraints, so a sample of 2015/16 patients was selected then tracked through the data from 2015/16 back to 2011/12. Total sample size was based on the largest overall cohort size that could be analysed in practice within Stata v12 MP, with a 1:3 ratio of index group (ARFAs) to each of the controls (ARNFAs, NANFAs, NAFAs) where possible.

Selecting the 2015/16 cohort for analysis by four patient groups

All 54,369 alcohol related frequent attenders identified from the national 2015/16 admissions data were included in the 2015/16 cohort. 136,015 alcohol related non-frequent attenders were included in the 2015/16 cohort and this was the entire national ARNFA group. Although the number of patients in the ARNFA group fell slightly short of the intended 3 x index group size, this was the entire national sample. Using Microsoft SQL Server Management Studio, a random sample of 150,000 patients from each of the non-alcohol non-frequent attending group and the non-alcohol frequent attending groups in 2015/16 were selected. Randomisation was achieved by allocating each individual patient within those groups a new row identification number (*NEWID* function) and then selecting 150,000 rows at random from each of the 2 groups. The make-up of the final 2015/16 cohort (for analysis by 4 groups) is summarized in table 10 below. The final 2015/16 cohort consisted of 490,384 people.

Table 10: Summary of the 2015/16 cohort and sampling for analysis by 4 patient groups

	No. of patients included in the sample	% of all patients in the 2015/16 national dataset included in the sample
ARFAs	54,369	100
ARNFAs	136,015	100
NAFAs	150,000	12.6
NANFAs	150,000	2.4
Total	490,384	6.41

A further round of sampling took place to allow analysis between 2 dichotomous groups: ARFAs versus non-ARFAs. All new ARFAs (no history of being an ARFA prior to 2015/16) were included as the study group and the single control group consisted of ARNFAs, NAFAs and NANFAs, in numbers proportional to their representation within the entire national sample i.e. 2%, 16% and 82% respectively.

3.10.3 Longitudinal analyses of alcohol related frequent attenders, using routinely collected hospital data, 2011-2016

Which factors predict becoming an ARFA in 2015 and what is the pattern of health service use prior to becoming an ARFA?

This analysis included patients selected from the 2015/16 data, as described intable 10, referred to as the 2015/16 cohort. Hospital admission records between 2011/12 -2015/16 for all ARFAs identified in England on the basis of their alcohol and frequent attending status during 2015, were analysed according to whether they were an ARFA for the first time in 2015/16 or had had a previous alcohol admission in 2011/12-2014/15 or been a frequent attender in 2011/12-2014/15. A new variable was created which differentiated patients who were ARFAs in 2015 but had never been an ARFA before (*new ARFA*), from those who had been an ARFA in at least one of the years between 2011 and 2014/15 and were an ARFA again in 2015/16.

The patterns of hospital admissions prior to 2015/16 were determined as were basic demographics (age, gender, income level) along with the nature of alcohol diagnoses and other comorbidities, using the following newly created variables:

- Presence of a chronic alcohol diagnosis (including ICD10 codes E244, G312, G621, G721, I426, K292, K700, K701, K702, K703, K704, K709, K852, K860);
- Having more than 3 alcohol admissions across all years;
- Having more than 3 inpatient admissions across all years (yes=1, no=0);
- Having more than 2 alcohol (WAAD) admissions in 1 year (yes =1, no=0); and
- Presence of a mental health diagnosis other than an alcohol-related condition (yes=1, no= 0).

A multinomial logistic regression model was developed using the variables described above. Findings for ARFAs were compared to the 3 control groups (ARNFAs, NANFAs, NAFAs), with relative risks calculated showing the likelihood of being an alcohol attender (ARFA or ARNFA) or a frequent attender (ARFA or NAFA), compared to being a non-alcohol non-frequent attender (NANFA).

Does the likelihood of transition to ARFA vary with time?

The analysis included patients from the 2015/16 data, as described in table 10, comparing the odds ratio of becoming an ARFA in 2015 versus not becoming an ARFA, on the basis of variables populated with data from years 2011-2014 combined; and also using data from individual years. A new variable was created which categorised all patients as to whether they were a new ARFA in 2015 or not i.e. became ARFAs for the first time in 2015/16. Patients who were an ARFA in 2015 but had also been an ARFA in a year prior to that were removed from the analyses. Results for all new ARFAs in 2015/16 (34,789 patients) were compared to one control group comprising ARNFAs, NAFAs and NANFAs, in numbers proportionate to representation in the entire national sample (see table 9). The control sample was selected randomly using Stata command *sample* from the patient groups in 2015/16, and included 3,360 ARNFAs, 28,710 NAFAs, and 150,000 NANFAs.

Logistic regression on the dependent binary variable "new ARFA in 2015/not an ARFA in 2015", was undertaken using the independent variables:

- age at start of admission;
- gender;
- IMD income score: the proportion of the population in an area experiencing deprivation relating to low income;
- The presence of a chronic alcohol diagnosis (WAAD) (including ICD10 codes E244, G312, G621, G721, I426, K292, K700, K701, K702, K703, K704, K709, K852, K860);
- Having more than 3 alcohol admissions across all years;
- Having more than 3 inpatient admissions across all years;
- Having more than 2 alcohol (WAAD) admissions in 1 year; and
- Presence of a non alcohol-related mental health diagnosis.

Odds ratios were calculated for the binary dependent variable new ARFA in 2015/16, versus all other categories of patient combined (ARNFA, NAFA and NANFA), using different combinations of data from the years 2011/12 -2014/15 (shown in table 11 below) and also using individual years' data to investigate whether the odds ratios (while controlling for all other factors) changed at varying time points prior to becoming an ARFA.

Table 11: Summary of data included in comparison of odds ratios

	2011/12	2012/13	2013/14	2014/15	2015/16
1 year prior	✓	✓	✓	✓	
2 years prior	✓	✓	✓		
3 years prior	✓	✓			
4 years prior	✓				

3.11 Study 4: Alcohol related frequent attenders: a 5-year longitudinal study of alcohol related liver disease and mortality

A 5-year dataset including records of all adult persons admitted to hospital (Hospital Episode Statistics) in England between 1st April 2011 - 31st March 2016 was obtained from NHS Digital through the Data Access Request Service. The very large dataset was initially managed using Microsoft SQL Server Management Studio software, to undertake counts of total patients included within each year, allocate patients to one of four groups based on their alcohol and frequent attending status and select patient cohorts for further longitudinal analysis.

3.11.1 Defining patients on the basis of alcohol admissions and frequent attending

As previously described all admitted patients were categorized in to one of four different patient groups depending on whether they had had an alcohol admission during the year and whether they had had more than 3 admissions to hospital during the year.

3.11.2 Missing data

Overall missing data for the 2015/16 cohort was estimated to be less than 6.0% so the data were analysed in its entirety with no corrections or estimations made to account for missing data.

3.11.3 Sample

For the longitudinal analysis a sample of 2011/12 patients were tracked forwards through the data from 2011/12 to 2015/16. Total sample size was based on the largest overall cohort size that could be analysed in practice within Stata v12 MP, with a 1:3 ratio of index group (ARFAs) to each of the controls (ARNFAs, NANFAs, NAFAs) where possible.

Selecting the 2011/12 cohort

All 51,934 alcohol related frequent attenders identified from the national 2011/12 admissions data were included in the 2011/12 cohort. 137,646 alcohol related non-frequent attenders were included in the 2011/12 cohort and this was the entire national ARNFA group. Although the number of patients in the ARNFA group fell slightly short of the intended 3 x index group size, this was the entire national sample. Using Microsoft SQL Server Management Studio, a random sample of 150,000 patients from each of the non-alcohol non-frequent attending group and the non-alcohol frequent attending groups in 2011/12 were selected. Random selection was achieved by allocating each individual patient within those groups a new row identification number (NEWID function) and then selecting 150,000 rows at random from each of the 2 groups. The details of the final 2011/12 cohort are summarized in table 12 below. The final 2011/12 cohort consisted of 489,580 patients with 4,740,217 finished consultant episodes.

Table 12: Summary of the 2011/12 cohort and sampling

	No. of patients included in the sample	% of all patients in the 2015/16 national dataset included in the sample
ARFAs	51,934	100
ARNFAs	137,646	100
NAFAs	150,000	13.9
NANFAs	150,000	0.025
Total	489,580	6.81

3.11.4 Incidence and prevalence of alcohol specific liver disease

Prevalence of alcohol specific liver disease amongst the 2011/12 cohort was measured across the 5 year period to 2011/12-2015/16. Alcohol specific liver disease included diagnoses with the following ICD10 codes-

- K700- alcoholic fatty liver;
- K701- alcoholic hepatitis;
- K702- alcoholic fibrosis and sclerosis of the liver;

- K703- alcoholic cirrhosis of the liver (includes with and without ascites);
- K704- alcoholic hepatic failure (includes with and without coma); and
- K709- alcoholic liver disease unspecified.

In addition, prevalence of end-stage alcohol specific liver disease was measured across the 5-year period 2011/12-2015/16, as recorded by the ICD10 codes:

- K703- alcoholic cirrhosis of the liver (includes with and without ascites); and
- K704- alcoholic hepatic failure (includes with and without coma).

Statistical significance of differences amongst prevalence rates were compared across the 4 patient groups using a Chi^2 test.

Incidence of ARLD and end-stage ARLD were also calculated for each of the 4 patient groups and compared. Only patients from the 2011/12 cohort with no incidence of ARLD recorded in the year 2011/12 were included in the analysis. Occurrence of new diagnoses of ARLD and end-stage ARLD between 2012/13 and 2015/16 were counted.

3.11.5 Mortality

This analysis included patients selected from the 2011/12 data, as described in table 12, known as the 2011/12 cohort. For this analysis, patients in the 2011/12 cohort were followed up for four years and death in hospital between 1st April 2011 and 31st March 2016 was the primary outcome measure. Death in hospital was measured using the *dismeth* variable in HES data, which records method of discharge for patients, coded as 4 for those who died in hospital.

Patients joined the study period on the date of their first admission during 2011/12. Patients who did not die in hospital during the study, left the study on 31/03/2016. For those who had not died in hospital during the study period 2011/12-2015/16, patients' time in the study (study days) was the number of days between the study end date and their admission date. For those who died during the study period, date of death was assumed to be the date of their final discharge where discharge method was coded as 4. For those who died, their time in the study (study days) was the number of days between the study start date and their final discharge date.

Cause of death is not included within the HES data therefore deaths from all causes were included in the analysis. Entries with erroneous dates were removed from the dataset (such as discharge dates earlier than admission dates, and any missing values). As a result records for 400,283 people (81.7%) remained in the sample from the original 489,533. Kaplan Meier survival curves were calculated for the four patient groups in the cohort according to their status in 2011/12: ARFAs, ARNFAs, NAFAs and NANFAs. The Kaplan Meier survival estimate is based on three assumptions:

- at any time patients who are censored (i.e. leave the study early but have not died) have the same survival prospects as those who continue to be followed;
- survival probabilities are the same for subjects recruited early as for those recruited late in the study; and
- the event happens at the time specified.

Statistically significant differences between the Kaplan Meier Survival curves for ARFAs and each of the three control groups (ARNFAs, NAFAs and NANFAs) were tested using the logrank test.

Hazard ratios for excess mortality (differences in mortality rates) for each of the four groups were calculated using Cox's proportional hazards regression, once proportional hazard assumptions had been tested using a log log plot. Cox's proportional hazards assumption assumes that the ratio of hazards between different exposure groups remains constant over time. Hazard ratios were adjusted for admission age and stratified in to five different age groups: under

44 years, 45-54 years, 55-64 years, 65-74 years and over 75's. Subsequently, age-adjusted 5-year survivor function, by patient type and age-group were calculated for each of the four patient groups. Cox regression based test for equality of survival curves was used to test for statistical differences.

3.12 Study 5: Prevalence of alcohol related frequent attenders in England and use of health services

A 5-year dataset including records of all adult persons admitted to hospital (Hospital Episode Statistics) in England between 1st April 2011 - 31st March 2016 was obtained from NHS Digital through the Data Access Request Service. The entire 5-year hospital admissions dataset for England, excluding poorly labelled or miscoded entries were included in the analysis. Included in the dataset were: all adult patients aged 18 years or over who have been treated in English hospitals between 01/04/2011 and 31/03/2016, whose hospital episode data has been captured, is complete and valid on NHS Digital's Hospital Episodes Statistics database.Management, cleaning, storage and processing of the dataset is described in sections 3.5 and 3.6. The 5 year dataset was analysed in 3 ways, each of which is described in more detail later in this section:

1. Cross-sectional analysis of prevalence of alcohol and frequent admission status for each of the 5 years
2. Longitudinal 5 year analysis of health service use prior to becoming an ARFA in 2015/16 (known as the 2015/16 cohort)
3. Longitudinal 5 year analysis of health service use of ARFAs identified in 2011/12 (known as the 2011/12 cohort)

3.12.1 Defining patients on the basis of alcohol admissions and frequent attending

As described earlier in this chapter all admitted patients were categorized in to one of four different patient groups (in any given year) depending on whether they had had an alcohol admission during the year and whether they had had more than 3 admissions to hospital during the year.

3.12.2 Calculating the prevalence of ARFAs

Cross-sections of the entire national dataset for each year were analysed using Microsoft SQL Server Management Studio. For each year between 2011/12 and 2015/16, all patients in the dataset were categorised in to one of four groups according to their alcohol and frequent attending status: alcohol-related frequent attenders (ARFAs), alcohol-related non-frequent attenders (ARNFAs), non-alcohol related frequent attenders (NAFAs) and non-alcohol non-frequent attenders (NANFAs).

3.12.3 Longitudinal analyses of alcohol related frequent attenders' hospital use

Longitudinal analyses of the 2011/12 and 2015/16 cohorts were undertaken in Stata v12 MP. The entire 2011/12 and 2015/16 national admitted patient datasets were too large to analyse in Stata so a sample of 2015/16 patients was selected then tracked through the data from 2015/16 back to 2011/12. Similarly a sample of 2011/12 patients was selected and followed forward through the data to 2015/16. Total sample size was based on the largest overall cohort size that could be analysed in practice within Stata v12 MP, with a 1:3 ratio of index group (ARFAs) to each of the controls (ARNFAs, NANFAs, NAFAs) where possible.

3.12.3.1 Pattern of health service use prior to becoming an ARFA: a 5-year retrospective study of ARFAs identified in 2015/16

This analysis included patients selected from the 2015/16 data, as described in section 3.10.2, referred to as the 2015/16 cohort. Hospital admission records between 2011/12 -2015/16 for all ARFAs identified in England on the basis of their alcohol diagnosis and frequent attending status during 2015, were analysed according to whether they were an ARFA for the first time in 2015/16 or not, had had a previous alcohol admission in 2011/12-2014/15 or been a frequent attender in 2011/12-2014/15. A new variable was created which differentiated patients who were ARFAs in 2015 but had never been an ARFA before (newARFA), from those who had been an ARFA in at least one of the years between 2011 and 2014/15 and were an ARFA again in 2015/16. The nature of hospital admissions, in terms of average number of admissions, lengths of stay and occupied bed-days prior to becoming an ARFA were determined. Findings for ARFAs were compared to the 3 control groups (ARNFAs, NANFAs, NAFAs).

3.12.3.2 Pattern of health service use for ARFA over 5 years: a prospective study of ARFAs identified in 2011/12

This analysis included patients selected from the 2011/12 data, as described in section 3.11.3, referred to as the 2011/12 cohort. Hospital admission records between 2011/12 -2015/16 for all ARFAs identified in England on the basis of their alcohol and frequent attending status during 2011/12 were analysed. The nature of hospital admissions, in terms of average number of admissions, lengths of stay and occupied bed days subsequent to becoming an ARFA were determined. Findings for ARFAs were compared to the 3 control groups (ARNFAs, NANFAs, NAFAs).

3.12.4 Calculating the cost of ARFAs over a 5-year period

Costs of the 2011 cohort over the subsequent 5-year period were estimated for each of the 4 patient groups using NHS reference costs for the relevant year. NHS reference costs are the calculated average unit cost to the NHS of providing secondary health care to NHS patients each year. Reference costs have been calculated on the basis of financial data that have been collected every year since 1997/8. Reference costs were originally developed so that treatment and procedure costs could be compared across the NHS.

To estimate costs to the NHS of the 2011 patient cohort using reference costs, 4 different types of spells were initially identified within the hospital admission records for the cohort:

- Day case spells;
- Elective (planned) inpatient spells;
- Non-elective (emergency or unplanned) inpatient short stay spells; and
- Non-elective (emergency or unplanned) inpatient long stay spells.

The first three types of spell in the list above all attract a fixed cost attributed to each healthcare resource group (HRGs) documented in the patient record. HRGs are codes which relate to the type and nature of diagnosis and corresponding treatment received. Average reference costs are based on a spell lasting a certain (average) length of time known as a trimpoint. Spells with lengths of stays which exceed the trimpoint are then charged on a daily basis for days in excess of the trimpoint known as excess bed days in addition to the cost of the average base spell. Using the national average spell costs including excess bed-days for long and shortstay spells and national average day rates for excess bed-days, the trimpoints for the average of each spell type (to produce the reference costs used in the national figures) were calculated. Trimpoints were calculated as 1.18 days for an elective inpatient admission and 2.33 days for a non-elective inpatient admission. The average spell reference costs (based on all England average costs for each year in the analysis) for each of these 4 types of spells was then applied to the 2011/12 cohort data (Department of Health 2012, Department of Health 2013, Department of Health 2014, Department of Health 2015, Department of Health 2016). Additional costs for excess bed-days were applied to all spells exceeding the trimpoints. Finally, having calculated the total costs including excess bed days for each of the four patient groups in the 2011 cohort across the 5 years, a mean cost per person (in each of the four patient groups in the initial cohort) was derived.

4 Identifying the characteristics of alcohol-related frequent attenders

4.1 Background

The systematic literature review (chapter 2) revealed that few studies have sought to identify the characteristics of ARFAs. Nonetheless, ARFAs are more likely to be male, homeless, aged between 31-50 years (Baune et al, 2005). ARFAs with liver disease had longer lengths of stay, more unplanned readmissions and higher death rates (Lekharaju et al, 2014). No papers were found directly comparing the characteristics of ARFAs to other (non-alcohol) frequent attenders.

This chapter presents epidemiological information about ARFAs and compares the socio-demographic characteristics of ARFAs with 3 other groups: non-frequent alcohol related attenders, frequent non-alcohol related attenders and non-frequent non-alcohol-related attenders at hospitals in England. This research employed electronic patient data from hospital episode statistics (HES), comprising routinely collected data on all hospital inpatient admissions in England, which is then collated and maintained by NHS digital. A pseudonymised one-year extract of South London admissions was analysed to ascertain: prevalence, age, gender, deprivation and co-morbidities for South London ARFAs and then compared to findings for 3 other groups of patients admitted to hospital in South London during 2013/14: non-alcohol-related, frequent attenders, non-alcohol-non-frequent attenders and alcohol-related-non-frequent attenders. Methods are described in chapter 3.

4.2 Analyses

4.2.1 Sample

The entire dataset excluding poorly labelled or miscoded entries were included in the analysis. Included in the dataset were: all adult patients aged 18 years or over, who were residents of South London, who have been treated in English hospitals between 01/04/2013 and 31/03/2014, whose hospital episode data was captured, complete and valid on NHS Digital's inpatient database. This sample included records from 366,616 people with 696,156 admissions.

4.2.2 Counts of persons and admissions

Counts of persons by each of the four groups ARFA, ARNFA, NANFA, NAFA and their corresponding FCEs and admissions (CIPS) were made using methodological approaches described in chapter 3 and comparisons made and described across the four patient groups.

4.2.3 Characteristics of ARFAs compared to other patient groups

An initial univariable analysis compared differences in age, total co-morbidities and deprivation (continuous variables) between the four patient groups (ARFAs, ARNFAs, NAFAs, NANFAs- see section 3.6.8 for definitions) using means and standard deviations, and frequencies and percentages for the categorical variable gender. ARFAs and controls were compared using one-way analysis of variance (ANOVA) for continuous variables (age, deprivation and count of co-morbidities) to test for statistical significance, and Chi-squared for the categorical variable, gender. A Bonferroni correction was carried out on the p-value for multiple testing and the corrected level of significance was $p<0.01$.

A logistic regression analysis using a combination of variables (age, gender, count of co-morbidities and income deprivation) was undertaken to calculate an odds ratio for being an ARFA. The data were analysed in terms of persons rather than admissions (CIPS). The model tested the combined effects of age, gender, income deprivation and the number of co-morbidities present on admission (excluding wholly attributable alcohol diagnoses) as predictors for being an alcohol-related frequent attender. Tests for interactions between variables were performed.

4.2.4 Factors influencing frequent hospital admissions

A further set of analyses explored persons rather than admissions and tested age, gender, income (measured by proportion of population in a postcode living in income deprivation) and the number of co-morbidities as predictors (odds) of frequent attendance. Tests for interactions between variables were performed.

4.2.5 Which demographic factors influence total hospital admissions?

A linear regression model analysed the impact of demographic characteristics (age, gender, deprivation, co-morbidities) on the total number of hospital admissions (all cause). Variables which were not normally distributed were transformed using natural log. A plot of the distribution of the transformed variable was created to check for normal distribution following transformation. Having run the linear regression model, residuals were plotted to test for heteroskedasticity.

4.2.6 Investigating factors which influence total number of alcohol related hospital admissions

A linear regression model analysed the impact of various demographic factors (age, gender, deprivation, co-morbidities) on the total number of alcohol-related hospital admissions. Non- normally distributed variables were transformed using natural log. A plot of the distribution of the transformed variable was created to check for normal distribution following transformation. Tests for interactions between variables were performed. Having run the linear regression model, residuals were plotted to test for heteroskedasticity.

4.3 Results

4.3.1 Prevalence of alcohol-related admissions

The following section presents results of the analysis of South London hospital admissions data for 2013/14.

During 2013/14, 366,616 people living in South London were admitted to hospital. Of these, 7132 people (1.95%) had at least one alcohol-related diagnosis on admission during the year. 51,215 people were admitted to hospital more than 3 times during the year and 1897 of this group also had at least one alcohol-related diagnosis at the time of admission ("alcohol-related frequent attenders" or ARFAs) as shown in table 13.

Table 13: The prevalence of alcohol related diagnoses and frequent (3+) admissions (2013/14)

		Frequent attendance		
		No	Yes	Total
People with an alcohol related diagnosis	No	310,166	49,318	359,484
	Yes	5235	1897	7132
	Total	315,401	51,215	366,616

In 2013/14 for South London there were a total of 696,156 continuous inpatient spells (CIPS) in hospital recorded, and of these, 355,415 CIPS (51.1%) were associated with people who frequently attended hospital (people who had 3 or more admissions during the year). 16,987 CIPS were associated with people who had had an alcohol-related diagnosis during at least one of their hospital admissions during the year. 10,130 CIPS were associated with ARFAs (see table 14 below). 11,009 admissions (CIPS) included a wholly-attributable alcohol diagnosis and just under half of these CIPS (47.2%, 5198 CIPS) were accounted for by alcohol related frequent attenders (ARFAs).

Table 14: Total CIPS (admissions) among frequent attenders and those with an alcohol related diagnosis

		Frequent attendance		
		No	Yes	Total
Alcohol related attendance	No	333,884	345,285	679,169
	Yes	6857	10,130	16,987
	Total	340,741	355,415	696,156

Table 15 provides the breakdown of people and admissions for South London during 2013/14. The table shows that over a quarter of people admitted to hospital for alcohol-related diagnoses were readmitted multiple (more than 3) times during the year: this is a higher proportion of patients becoming frequent attenders than for all other causes (14.0%). The 26.6% of all admitted patients who are alcohol-related frequent attenders, accounted for just under 60% of all alcohol-related admissions during 2013/14.

Table 15: Summary of number of people admitted to hospital and total number of episodes among all people, frequent attenders and those with an alcohol related condition

	People	No. of admissions (CIPS)
Admissions to hospital	366,616	696,156
Frequent (3+) attenders for all causes (% of total)	51,215 (14.0%)	355,415 (51.1%)
Alcohol related admissions	7132	16,987
Alcohol-related frequent attenders (% all alcohol related admissions)	1897 (26.6%)	10,130 (59.6%)

The next sections compare characteristics of ARFAs with the three other patient groups.

4.3.2 Age

Mean age at the start of admission for the entire 2013/14 South London admitted cohort was 52.4 years. Mean age at the start of admission was calculated for each of the four patient groups identified: ARFA, ARNFA, NANFA, NAFA and results are shown below in table 16.

Table 16: Mean age (years) of persons from South London admitted to hospital in 2013/14

		Frequent attenders		
		No	Yes	Total
People with an alcohol related diagnosis	No	51.58 .04 (273,982)	56.86 .10 (48,125)	(322,107)
	Yes	49.97 .22 (5,234)	55.36 .35 (1897)	(7131)
	Total	(279,216)	(50,022)	(329,238)

Cells show mean age (years), SD, N.

Comparison of means shows that alcohol related frequent attenders (ARFAs) were older on average than alcohol related non-frequent attenders (55.4yrs vs 50.0yrs, $p<0.001$) and non-alcohol related non-frequent attenders (55.4yrs vs 51.6 yrs, $p<0.001$) but younger than non-alcohol related frequent attenders (55.4yrs vs 56.9yrs, $p<0.01$), $F (3,329234) = 956.20$, $p<0.0001$.

Comparison of mean age of ARFAs, with all non-ARFAs grouped together (NAFA, NANFA and ARNFA), showed that ARFAs were older than non-ARFAs (55.4 years versus 52.3 years, $p<0.001$), $F (1,329146) =41.51$, $p<0.001$.

4.3.3 Gender

Data were analysed to assess the proportion of males and females in each of the four patient groups (NANFA, NAFA, ARNFA, ARFAs). Table 17 below shows that most alcohol related frequent attenders were male. Nevertheless, overall there were many more hospital admissions for women than men (202,831 females versus 126,292 males). However, despite the gender imbalance in overall admissions, males are more highly represented in both frequent and non-frequent attenders than women. For non-alcohol related admissions, the gender imbalance was reversed: 63.3% of non-alcohol related admissions were for women. There appears to be little difference in the proportions of men with alcohol related diagnoses in each of the frequent and non-frequent attender categories.

Table 17: Alcohol related and frequent hospital admissions by gender

		Frequent attendance		
		No	Yes	Total
People with an alcohol related diagnosis	No	Male 103,438 (37.8%) Female 170,451 Total 273,889	Male 17,866 (37.1%) Female 30,239 Total 48,105	Male 121,304 (37.7%) Female 200,690 Total 321,994
	Yes	Male 3,615 (69.1%) Female 1,617 Total 5,232	Male 1,373 (72.4%) Female 524 Total 1,897	Male 4,988 (70.0%) Female 2,141 Total 7,129

Cells show frequency of persons, % by gender, N.

Comparison of the frequency of each category of gender in each of the 4 patient groups was made and statistical significance tested using χ^2 test. The results show χ^2 (3, N=329,238) =3.1 x 10^3, $p<0.001$ demonstrating that the gender difference between groups is significant.

4.3.4 Deprivation

Results of the analysis of income deprivation (using the Income of Multiple Deprivation- IMD- income score alone) by each of the four patient groups are shown in table 18 below.

The ARFA group had the highest mean income score, compared to the other 3 groups, meaning persons within the ARFA group reside in areas with higher mean proportions of people experiencing income deprivation compared with persons within the NANFA, ARNFA and NAFA groups.

Table 18: Mean (sd) income deprivation score by patient group

		Frequent attendance		
		No	Yes	Total
People with an alcohol related diagnosis	No	0.165 (0.098) 310,166	0.168 (0.097) 49,318	359,484
	Yes	0.186 (0.095) 5,235	0.194 (0.096) 1,897	7,132
Total		315,401	51,215	366,616

Summary of income deprivation score: mean, standard deviation, frequency

Comparison of mean income score showed that ARFAs lived in areas with the greatest proportion of people experiencing income deprivation (0.194 or 19.4%) than other groups F (3,366612) = 134.73, p<0.0001. The NANFA group had the lowest mean income score (0.165 or 16.5%) i.e. the smallest proportion of people experiencing income deprivation.

4.3.5 Total number of co-morbidities

For each of the four groups of patients (NANFA, NAFA, ARNFA and ARFA) the mean number of diagnoses made on presentation excluding any alcohol diagnoses was calculated and compared across the groups (see table 19 below).

Table 19: Mean number of diagnoses by patient group

		Frequent attendance		
		No	Yes	Total
People with an alcohol related diagnosis	No	1.83 *1.72* (273,982)	2.17 *1.99* (48,125)	(322,107)
	Yes	3.88 *1.90* (5,234)	4.07 *2.11* (1897)	(7131)
	Total	(279,216)	(50,022)	(329,238)

Key: Mean, SD, (frequency)

Analysis of variance indicated that there was a highly significant difference in the mean number of diagnoses across the four groups. Comparison of mean number of co-morbidities by patient group, as shown in table 19, revealed that as a group, ARFAs had the most diagnoses on presentation (mean 4.07 diagnoses) and NANFAs the fewest diagnoses (mean 1.83 diagnoses)
$F(3,329234) = 3655.75$ $p<0.0001$.

Although the NANFA group had the lowest mean number of diagnoses, some patients within this group had 14 comorbid diagnoses, although these patients were considered outliers. ARFA and NAFA groups also included patients with similarly high numbers of co-morbid diagnoses. The box plot below (figure 6) shows the median number of co-morbidities and interquartile ranges for each of the four patient groups.

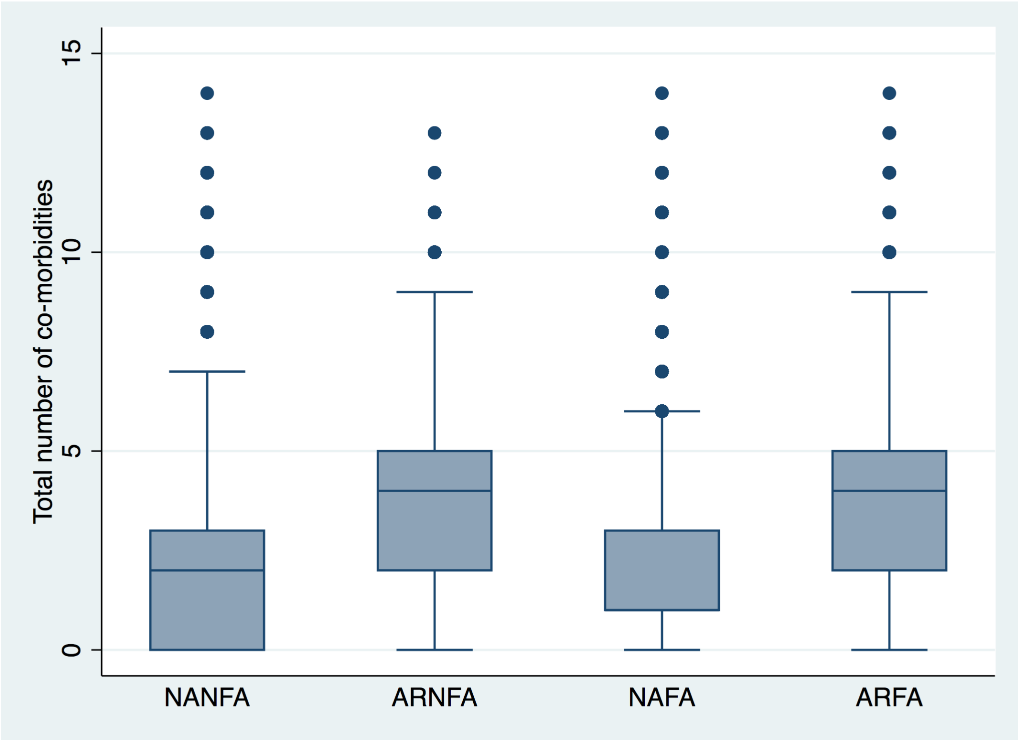

Figure 6: Box plot of median number of co-morbidities with range and outliers for each patient group

The analyses so far have examined the single characteristics of patients within the dataset and compared across the four patient groups in turn. All of the results are summarised in table 20 below. The next section of this chapter explores combinations of these characteristics and how outcomes vary between patient groups.

Table 20: Summary of characteristics of patients admitted to hospital, compared across four patient groups, with ARFA group as reference

Characteristic	Patient group versus ARFA	Value	Significant difference vs ARFA reference	
			ANOVA p-value	Chi^2 test p-value
Age (years)	ARFA	55.36	ref	-
	ARNFA	49.97	<0.001	-
	NAFA	56.86	<0.01	-
	NANFA	51.58	<0.001	-
	All non-ARFAs (NAFA, ARNFA, NANFA)	52.33	<0.001	-
Gender (% male)	ARFA	72.4	-	ref
	ARNFA	69.1	-	<0.001
	NAFA	37.1	-	<0.001
	NANFA	37.8	-	<0.001
	All non-ARFAs (NAFA, ARNFA, NANFA)	38.2	-	<0.001
Deprivation score*	ARFA	0.194	ref	-
	ARNFA	0.186	<0.001	-
	NAFA	0.168	<0.001	-
	NANFA	0.165	<0.001	-
	All non-ARFAs (NAFA, ARNFA, NANFA)	0.165	<0.001	-
No. co-morbidities (mean)	ARFA	4.07	ref	-
	ARNFA	3.88	0.001	-
	NAFA	2.17	<0.001	-
	NANFA	1.83	<0.001	-
	All non-ARFAs (NAFA, ARNFA, NANFA)	1.91	<0.001	-

* proportion of population experiencing income deprivation

4.3.6 Combined characteristics and odds of being an alcohol-related frequent attender

A logistic regression model using the variables ARFA (ARFA vs all other patients), age at start of CIP, gender, the proportion of the population in an area experiencing deprivation relating to low income and number of co-morbidities generated odds ratios for being an ARFA based on each characteristic. Results are shown in table 21 below.

Table 21: 0dds ratios, (95% confidence intervals) between ARFA status and measures of sociodemographic characteristics and diagnoses

	Odds ratios (95% CIs)
Age at start of admission	0.984 (0.981-0.986)
Male	3.607 (3.258-3.994)
Income deprivation	11.586 (7.383-18.182)
Count of diagnoses	1.593 (1.562-1.625)

Controlling for gender, deprivation and co-morbidity, the odds of being an ARFA reduced by 2% for each additional year of age (OR 0.98 p<0.001). Controlling for age, deprivation and co-morbidity, men were almost 4 times more likely to be ARFAs than females (OR 3.61, p<0.001). The odds of being an alcohol-related frequent attender were over 11 times higher (OR 11.6 p<0.001) in areas of highest income deprivation, controlling for age, gender and co-morbidities. Taking in to account the total number of co-morbidities a person had and controlling for age, gender and income, with each additional diagnosis of a co-morbidity, the odds of being an ARFA increased by 1.6 times (OR 1.59 p<0.001).

4.3.7 Interactions between age and gender on odds of being an alcohol-related frequent attender

The results above suggest potential interactions between age and gender, particularly in relation to alcohol related admissions and frequent attending. The following analyses were undertaken to test whether interactions were occurring.

The results of the test for interaction between age and gender showed that there was a significant interaction between age and gender (z=-6.56, p<0.001). A plot of the estimated interaction is shown in figure 7 below.

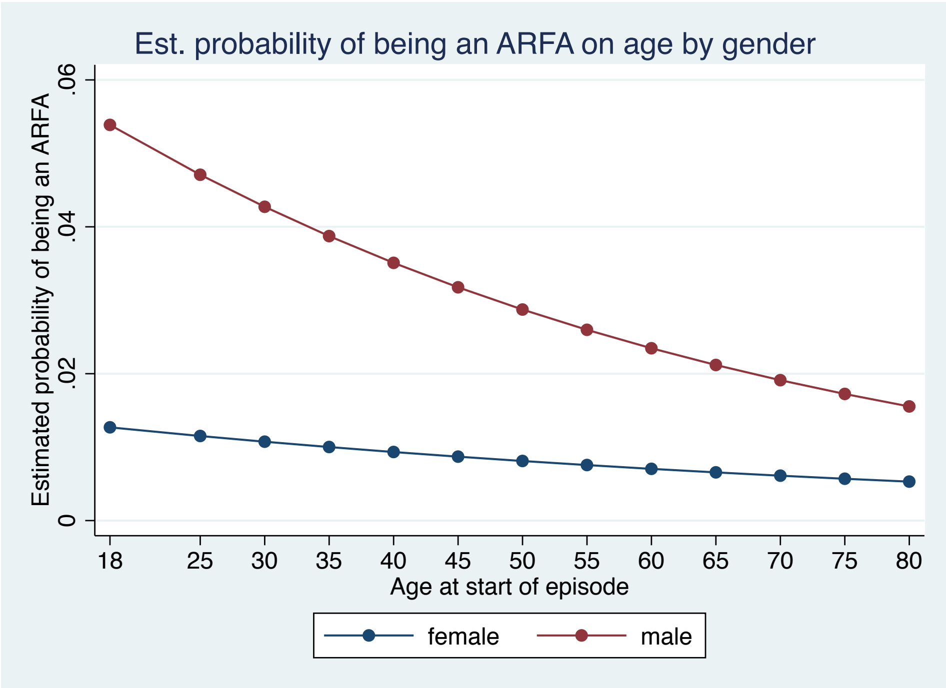

Figure 7: Interaction between age and gender on risks of being an ARFA

As shown in figure 7 above, for each age group, the probability of being an ARFA varies between men and women, with young males having the greatest probability of being an ARFA, and older women the lowest. For both males and females, the probability of being an ARFA reduces with age, but at a much faster rate for males than females. The rate of reduction of probability of being an ARFA varies little for women at all ages.

Whilst this interaction explains differences in the effect size (odds of being an ARFA), and takes into account gender and age, it does not explain why ARFAs are older on average than non-ARFAs. Based on figure 7 above, one might have expected that ARFAs would be younger than non-ARFAs (i.e. have a lower mean age at the start of admission), given that the odds of being an ARFA are higher at a younger age. The fact that the reverse is true i.e. ARFAs have a higher mean age than non-ARFAs implies that another factor must be also be influencing alcohol-related frequent attendance. One possible explanation could be that there is a tendency for greater numbers of older people to be admitted to hospital, for all causes of admissions or just for alcohol admissions. Both of these factors could push up the average age of an ARFA. These factors are investigated in the next section.

4.3.8 Factors influencing frequent hospital admissions for all causes

In contrast to the previous analyses focusing on admissions, a further set of analyses was conducted to examine the correlates of being a frequent attender (having more than 3 admissions during the year for any cause but no wholly attributable alcohol diagnosis). Potential correlates included: age, gender, income (measured by proportion of population in a postcode living in income deprivation) and the number of co-morbidities present on admission.

For the entire South London population admitted to hospital during 2013/14, the mean age of persons admitted to hospital was 52.4 years. More females (61.7%) than males were admitted. On average each person admitted had 1.9 diagnoses.

A logistic regression was carried out to investigate variations in effect size (odds ratios) on the dependent variable, frequent attender in conjunction with the independent variables: age at start of admission, gender, the proportion of the population in an area experiencing deprivation relating to low income and number of diagnoses. Results of the logistic regression are shown in table 23 below.

Table 22: Odds ratios of being a frequent attender (all causes) based on measures of sociodemographic characteristics and diagnoses (odds ratios, ORs) with 95% confidence intervals (CI)

	Odds Ratios (95% CIs)
Age at start of admission	1.011 (1.011-1.012)
Male	0.919 (0.901-0.937)
Income deprivation	2.181 (1.978-2.408)
Count of co-morbidities	1.064 (1.058-1.070)

The odds of being a frequent attender were 2.2 times higher (OR 2.18 p<0.001) in areas of highest income deprivation, controlling for age, gender and co-morbidities. Taking in to account the total number of diagnoses a person had and controlling for age, gender and income, with each additional diagnosis of a co-morbidity, the odds of being a frequent attender increase by 6.4% (OR 1.06 p<0.001).

Controlling for gender, deprivation and co-morbidity, the odds of being a frequent attender increased by 1.0% for each additional year of age (OR 1.01 p<0.001). This is in keeping with findings from the univariable analysis where non-alcohol related frequent attenders had a higher mean age than non-alcohol non-frequent attenders.

In the logistic regression, controlling for age, deprivation and co-morbidity, men were 9.1% less likely to be frequent attenders than females (OR 0.92, p<0.001). In the univariable analysis there appeared to be little difference in percentages of males/females between the non-alcohol non-frequent attenders and the non-alcohol frequent attenders. Changes in the effect size (odds ratio) appeared to be minimal within the logistic regression when age at start of admission and gender were combined, suggesting the potential masking of the effect of gender. To investigate this, a test for interaction between gender and age was undertaken and this is described in the next section.

4.3.9 Interactions between age and gender on odds of being a frequent attender

The results above suggest a potential interaction between age and gender on risks of frequent attending. Following logistic regression modeling as reported in section 4.3.7 above, analysis of interaction between age and gender on odds of being a (non-alcohol related) frequent attender (using methods previously described in section3.8.4) was conducted. Results of the test for interaction showed that there was a significant interaction between age and gender ($z=38.19$, $p<0.001$). A plot of the estimated interaction is shown in figure 8 below.

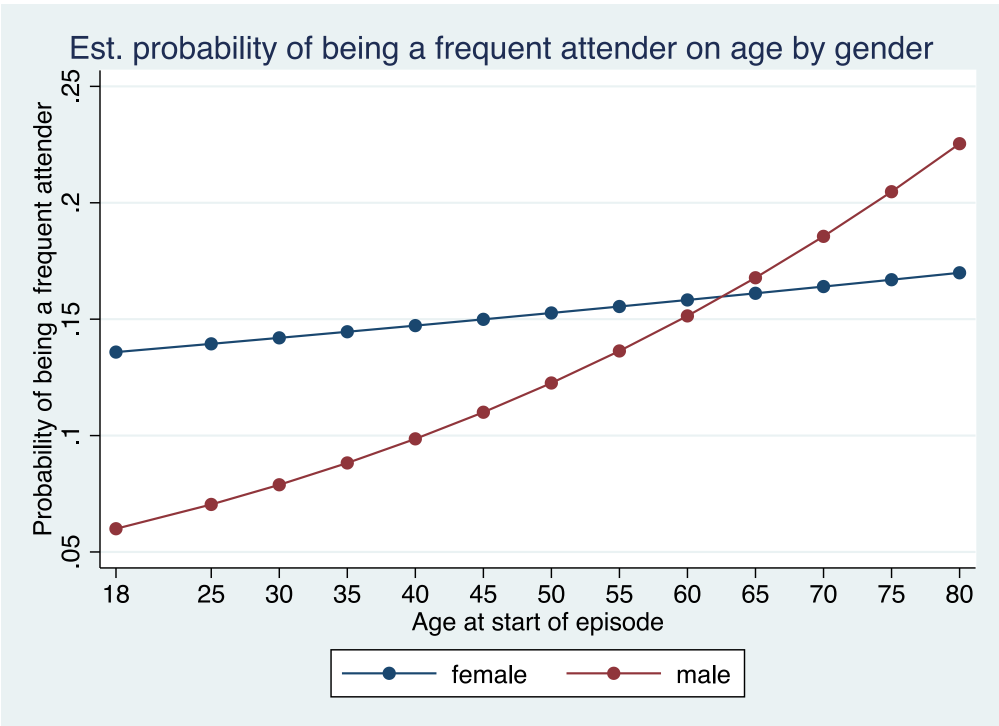

Figure 8: Age and gender predicting probability of being a frequent attender, with interaction term

The plot shows how gender affects the probability of being a frequent attender to differing degrees at various age points and that there is an interaction between age and gender on probability of being a frequent attender. For older age groups males have a greater probability of being a frequent attender, whereas the converse is true at younger age groups, where females are more likely to be a frequent attender. The rate of increase in probability of being a frequent attender with increasing age is steeper and non-linear for men compared to women.

4.3.10 Which demographic factors influence total hospital admissions for all causes?

A linear regression model examined the relationship between the total number of admissions (CIPS) per person and demographic factors. Preliminary investigation of this variable showed it was not normally distributed and was positively skewed with thin tails: mean 2.11, skewness 19.3 (normal=0) and kurtosis 430.7 (normal=3.00). Therefore, the variable was transformed using natural log to produce a more normally distributed variable with mean 1.46, less skewness (1.09) and less kurtosis (3.09) than prior to transformation.

A linear regression model of log of total admissions (for all causes) including age, gender, income and number of diagnoses explained 9.4% of the total number of hospital admissions, $F(4,696066) = 18{,}069$, $p<0.001$, and this was a weak/moderate relationship. There was a highly significant relationship between the number of hospital admissions for an individual and the four predictors age, gender, income and number of co-morbidities. Age and co-morbidities both had a moderate and statistically significant effect: age $\beta=0.248$, $p<0.001$, co-morbidities $\beta=-0.203$, $p<0.001$. Gender and income had weaker but statistically significant effects: gender $\beta=-0.110$, $p<0.001$, income $\beta=0.138$, $p<0.001$. A plot confirmed that the residuals of the model were normally distributed (see appendix 11.2).

Controlling for age, gender, deprivation and co-morbidities, being older age, female and income deprived are all predictors of increased number of hospital admissions (all cause). According to this model having a higher number of co-morbidities result in fewer hospital admissions (all cause), controlling for age, gender and deprivation.

As shown in figure 9 below, the variance of the residuals in the linear regression model is unequal across the range of values. The model therefore appears less effective at predicting those who will have low or high numbers of admissions. As total admissions increases, the variance of the residuals increases i.e. there is heteroskedasticity of residuals and increasing error variance. For the highest number of admissions, there is less variance.

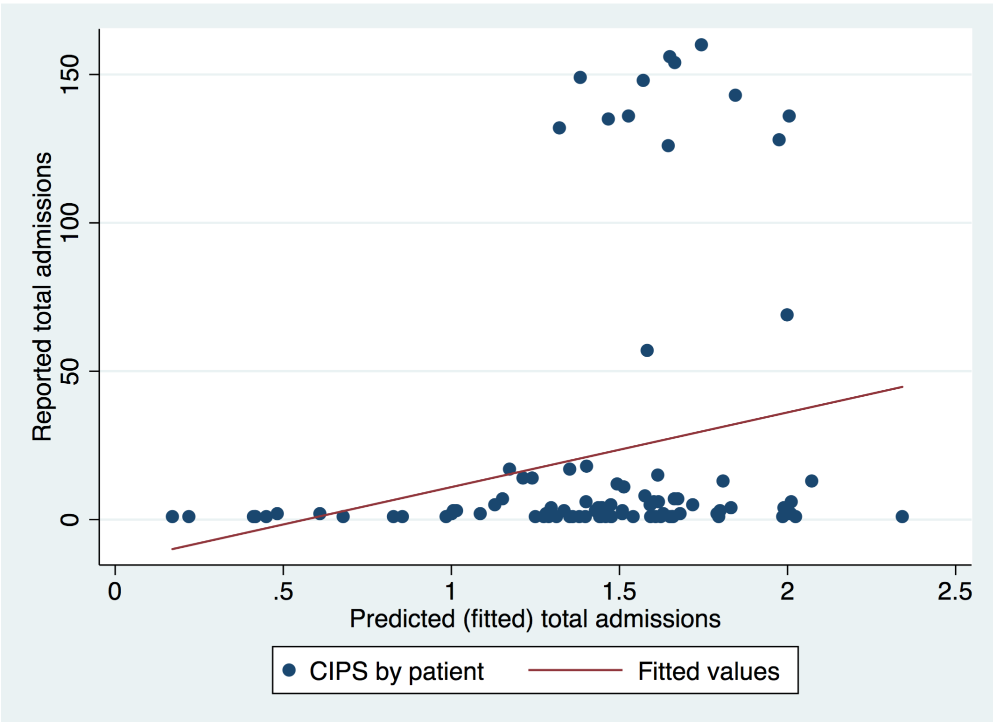

Figure 9: Actual value of total number of admissions (CIPS) per year versus predicted total admission

4.3.11 Which demographic factors influence total number of alcohol related hospital admissions?

A linear regression model examined the relationship between the total number of alcohol related admissions (CIPS) per person and demographic factors. Preliminary investigation of this variable showed it was not normally distributed and was positively skewed with thin tails: mean 0.06, skewness 20.8 (normal=0) and kurtosis 613.2 (normal=3.00). Therefore, the variable was transformed using natural log to produce a more normally distributed variable with mean 0.56, less skewness (1.16) and less kurtosis (3.57) than prior to transformation.

A linear regression model of log of total alcohol admissions including age, gender, income and number of co-morbidities explained 2.4% of the total number of alcohol related hospital admissions, $F(4,16981) = 107.21$, $p<0.001$ and this was a weak/moderate relationship. Diagnoses, age, gender and income had weak but statistically significant effects: diagnoses $\beta=-0.131$, $p<0.001$; age $\beta=-0.025$, $p<0.001$; gender $\beta=-0.070$, $p<0.001$; income $\beta=0.046$, $p<0.001$. A plot confirmed that the residuals of the model were normally distributed (see appendix 10.2).

Controlling for age, gender, deprivation and co-morbidities, being younger age, male and income deprived are all predictors of increased number of alcohol related hospital admissions (all cause). According to this model having a fewer number of co-morbidities result in more alcohol related hospital admissions, controlling for age, gender and deprivation.

Based on earlier results (see section 4.3.6) where an interaction was shown between age and gender on likelihood of being an alcohol-related frequent attender, interaction effects were investigated for total alcohol-related hospital admissions by age and gender and plotted in figure 10 below.

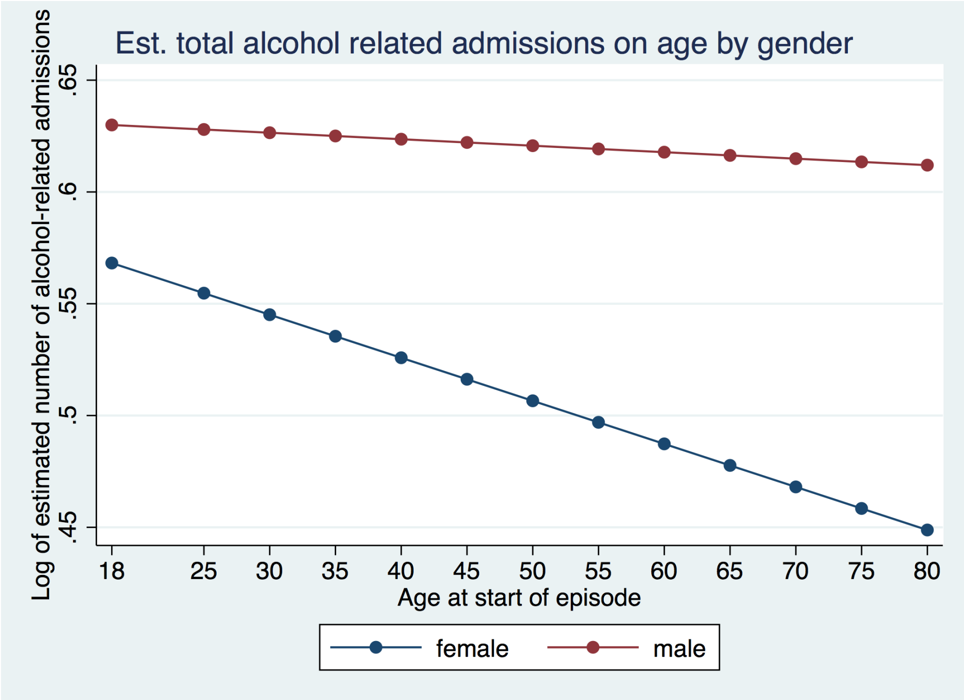

Figure 10: Age and gender predicting total alcohol-related hospital admissions, with interaction term

Test for interaction shows a significant interaction between age and gender on total alcohol admissions t=2.56, p=0.011. Adding the interaction term to the original linear regression model showed that the later model accounted for 2.5% of the variance in total alcohol related admission F (5, 16980) =87.10, p<0.001 and this was a weak relationship.

4.4 Summary

This study showed that over a quarter of people admitted to hospital for alcohol-related diagnoses were readmitted multiple (more than 3) times during the year. The 26.6% of all patients admitted for alcohol who are frequent attenders, accounted for just under 60% of all alcohol-related admissions during 2013/14. This suggests that alcohol-related frequent attenders are placing a disproportionately large burden on the NHS.

The results presented show that age, gender, deprivation and co-morbidities are all defining characteristics of ARFAs. On average ARFAs are older, more likely to be male, residing in income deprived areas and have more diagnoses than other patients admitted to hospital. These findings support those from the systematic literature review (chapter 2) which revealed that ARFAs are more likely to be male, homeless, aged between 31-50 years (Baune et al, 2005).

The findings suggest that ARFAs are different to frequent attenders admitted for other (non-alcohol) causes. When comparing ARFAs to all other admissions together, ARFAs are older (55.4 years versus 52.3 years, $p<0.001$). Compared to other frequent attenders, ARFAs are younger as a group than non-alcohol-related frequent attenders (55.4yrs vs 56.9yrs, $p<0.01$) suggesting that age is a differentiating characteristic of alcohol-related frequent attenders compared to non-alcohol related frequent attenders.

According to the South London 2013/14 data, most ARFAs are male. When controlling for age and other factors, men are almost 4 times more likely to be ARFAs than females. This is perhaps surprising given that the majority of all hospital admissions in 2013/14 for South London were for women, and indeed non-alcohol related frequent attenders are much more likely to be female than male. However, a much higher proportion of males than females were admitted for alcohol related reasons during 2013/14 (frequent and non-frequent attenders). So the fact that more ARFAs are male may be because as a group they are more similar to people having alcohol-related admissions, rather than being more similar to frequent attenders for other causes. In terms of differentiating between someone having one or multiple admissions to hospital for an alcohol-related cause, a linear regression model showed age and gender to have weak but statistically significant effects on alcohol related hospital admissions whilst controlling for income and co-morbidities: being younger age and male were predictors of having an alcohol-related admission.

This analysis suggests that ARFAs make up a greater proportion of admissions at younger age groups, compared to older ages, but the total number of admissions at these younger ages (for all causes including ARFAs) are lower than for older age groups. We know most ARFAs presenting to hospital tend to be in their mid-50s. This may reflect differences in the type of alcohol diagnoses that a person has: younger males may be more likely to present much more frequently with acute intoxication at a young age than older patients who may present with the chronic effects of alcohol use such as liver disease or pancreatitis. This hypothesis is explored in more depth in the next chapter.

The regression models developed showed that the four characteristics (age, gender, deprivation, co-morbidities) investigated in this study explain some of the variation in number of admissions to hospital and alcohol-related admissions to hospital, but not all. Therefore, we cannot say that these characteristics are wholly predictive of being an ARFA and other factors, yet unknown, must also play a part.

5 Are alcohol-related frequent attenders “complex” patients?

5.1 Background

The systematic literature review (chapter 2) found that physical and mental health comorbid conditions are common amongst ARFAs. A small case series of 41 ARFA patients reported that patients with early unplanned readmissions (within 1 month of previous readmission) experienced more hospital admissions, with longer hospital stays, compared to those without early unplanned readmissions. In this study, severity of liver disease and comorbidities were not found to be significantly associated with readmission. (Fagan et al, 2014).

A second study also identified that ARFAs with liver disease had longer lengths of stay, more unplanned readmissions and higher death rates (Lekharaju et al, 2014). More recently, an in-depth qualitative study of 30 alcohol related frequent attenders found that almost all experienced multiple chronic physical health problems as a result of their drinking (Neale et al, 2017). All these findings are suggestive of a complex clinical picture for ARFAs, but it is not known whether ARFAs are any more complex than either other frequent attenders or other (non-frequent) alcohol attenders and this study aims to address this question.

Although there is no standardised definition of “complex needs”, comorbidity has been proposed as an important element (Aujesky, Donze and Crelier, 2016). By investigating comorbidity, this study compares the complexity of ARFAs to other admitted patients by prevalence of common conditions, mean number of comorbidities and frequency of severe comorbidity using the Charlson comorbidity index, to see if ARFAs are any more complex than other admitted patients.

Comorbidity indices can be used in conjunction with administrative care records or patients' case notes to predict clinical outcomes such as mortality within 1 year, or the impact on services such as the scale of nursing care required. The indices consist of weighted scores attributed to patients based on the type and severity of their disease(s). There are several existing validated measures of comorbidity in addition to the Charlson Index (Charlson et al, 1997), including the Cumulative Illness rating scale-CIRS (Linn et al, 1968), Index of coexisting disease- ICED (Athienites et al, 2000) and Elixhauser comorbidity index (Elixhauser et al, 1998), but with little documented use in predicting alcohol admissions or outcomes. The Charlson index was chosen for use in this study as it has been widely validated for use with hospital administrative care records and the index specifically includes mild, moderate and severe liver disease, along with a wider range of other comorbidities, all of which are relevant to ARFA patients (see section 3.8.3 in Methods chapter for more details.)

5.2 Aims of the study

The study addresses the following research questions:

1. What physical and mental health conditions do alcohol-related frequent attenders (ARFAs) present with at hospital?
2. Do ARFAs have more physical and mental comorbid health conditions than other patients?

This study compared diagnostic information for alcohol related frequent attenders (ARFAs) with the 3 other patient groups: non-alcohol related frequent attenders, alcohol-related non-frequent attenders and non-alcohol related non-frequent attenders, in order to better understand how complex ARFAs are compared to other patients in terms of their physical and mental health. These four patient groups have been described previously (See chapter 3).

5.3 Analyses

The study compared the health status of ARFAs with 3 other groups: alcohol related non-frequent attenders, non-alcohol related frequent attenders, and non-alcohol-related non-frequent attenders at hospitals. The study examined the diagnosis codes, labelled according to ICD10 classification, within the 20 available diagnostic fields within the HES inpatient data. Using this data, the study documented:

1. Primary presenting diagnosis for each of the four patient groups;
2. Total number of alcohol related diagnoses by each of the four patient groups and by gender;
3. Comparison of mean number of co-morbidities by each of the four patient groups;
4. Assessment of co-morbidities for each patient group using a co-morbidity index;
5. Prevalence and relative risk of particular co-morbidities by each of the four patient groups; and
6. Prevalence of mental health diagnoses amongst the four patient groups.

5.4 Sample

The entire dataset of hospital admissions for South London during 2013/14, excluding poorly labelled or miscoded entries, were included in the analysis. Included in the dataset were: all adult patients aged 18 years or over, resident in South London, who have been treated in English hospitals between 01/04/2013 and 31/03/2014, whose hospital episode data has been captured, is complete and valid in hospital episode statistics database. The sample included records from 366,616 people and 696,156 admissions.

5.5 Results

5.5.1 Primary presenting diagnosis by patient group

Within the HES data, the primary condition with which the patient presents at hospital is recorded as a variable in its own right. The following section describes the conditions which were most commonly recorded for each of the four patient groups and what proportion of all admissions each primary presenting diagnosis accounted for, by patient group.

For ARFAs, 3 conditions wholly attributable to alcohol featured in the top 5 primary diagnoses: alcohol withdrawal, alcoholic cirrhosis of the liver and acute intoxication from alcohol, and together accounted for 9.3% of all admissions (measured as continuous inpatient spells, CIPS) for ARFAs (see table 23 below). The most common primary diagnosis for ARFAs was chronic kidney disease (stage 5 also known as end stage renal disease). Whilst hypertension is regarded as a renal condition partially attributable to alcohol, the diagnosis of end stage renal failure is not directly attributed to alcohol (Jones and Bellis, 2013). Other disorders of physical health recorded frequently as primary presenting diagnoses include urinary tract infection (UTI), chronic obstructive pulmonary disease (COPD), chest pain and pneumonia. There are many more physical health conditions amongst the most common primary diagnoses than mental health conditions. In the top 10 primary presenting diagnoses for ARFAs, paracetamol overdose features, which is not directly attributable to alcohol. However, the use of alcohol is closely linked to both intentional and unintentional paracetamol poisoning. There is a lack of good quality clinical evidence from prospective trials that alcohol consumption increases the risk of paracetamol toxicity however, it has been suggested that paracetamol toxicity may be more severe in patients with chronic alcohol misuse because they present late (Caparrotta, Daniel and Dear, 2018). Tendency to fall, syncope and collapse also feature as common primary presenting conditions for ARFAs.

Table 23: Most common presenting diagnoses and corresponding CIPS for ARFAs

ICD10 code	Primary presenting diagnosis	No. of CIPS	% of all CIPS for ARFAs
N185	chronic kidney disease stage 5	373	3.68
F103	alcohol withdrawal	344	3.40
K703	alcoholic cirrhosis of the liver	320	3.16
F100	acute intoxication from alcohol	276	2.72
N390	UTI site not specified	172	1.70
J440	COPD with acute LRTI	155	1.53
T391	poisoning by 4-aminophenol derivatives (paracetemol)	151	1.49
R074	chest pain unspecified	140	1.38
J181	lobar pneumonia, unspecified	133	1.31
G409	epilepsy, unspecified	126	1.24
R296	tendency to fall	113	1.12
R55X	syncope and collapse	112	1.11
J441	COPD with acute exacerbation	108	1.07
C900	multiple myeloma	106	1.05
C349	malignant neoplasm bronchus/lung	105	1.04
R18X	ascites	103	1.02

The most commonly presenting primary diagnoses for ARFAs are similar to those for other alcohol-related but non-frequent admissions (ARNFAs), though there are more wholly attributable alcohol diagnoses amongst the most common primary diagnoses for ARNFAs than ARFAs. Head injuries are also a common primary cause for alcohol-related non-frequent admissions. Two non-alcohol related mental health conditions feature amongst the most common presenting diagnoses: paracetamol poisoning and anti-depressant poisoning.

Table 24: Most common presenting diagnoses and corresponding CIPS for ARNFAs

ICD10 code	**Primary presenting diagnosis**	**No. of CIPS**	**% of all CIPS for ARNFAs**
F100	acute intoxication from alcohol	356	5.19
F103	alcohol withdrawal	331	4.83
T391	poisoning by 4-aminophenol derivatives (paracetemol)	251	3.66
T432	poisoning by unspecified antidepressants	118	1.72
K703	alcoholic cirrhosis of the liver	106	1.55
J181	lobar pneumonia, unspecified	99	1.44
I48X	atrial fibrillation and flutter	92	1.34
R568	other and unspecified convulsions	92	1.34
R074	chest pain unspecified	89	1.30
R55X	syncope and collapse	84	1.23
S099	unspecified injury of head	75	1.09
S008	superifical injury head	70	1.02
S018	open wound of head	70	1.02
K920	haematemesis	68	0.99
K852	alcohol-induced acute pancreatitis	67	0.98
K709	alcoholic liver disease, unspecified	64	0.93

Comparing presenting conditions for alcohol related frequent attenders with presenting conditions for non-alcohol related frequent attenders, NAFAs, (table 25) shows that NAFAs most common presenting diagnoses are physical health conditions, with (in common with ARFAs) chest pain, kidney disease, UTI and pneumonia all featuring amongst the most frequently presenting primary diagnoses. There are no mental health diagnoses among the most commonly primary presenting diagnoses for non-alcohol related frequent attenders.

Table 25: Most common presenting diagnoses and corresponding CIPS for NAFAs

ICD10 code	Primary presenting diagnosis	No. of CIPS	% of all CIPS for NAFAs
R104	other and unspecified abdominal pain	4114	1.19
R074	chest pain, unspecified	4104	1.19
O701	second degree perineal laceration during delivery	3792	1.10
O368	maternal care for other specified fetal problems	3712	1.08
O268	other pregnancy related condition incl. exhaustion and fatigue, renal disease	3660	1.06
N390	UTI, site not specified	3370	0.98
N189	chronic kidney disease, unspecified	3316	0.96
N185	chronic kidney disease: stage 5	3315	0.96
K573	diverticular disease of the large intestine without perforation or abscess	2500	0.72
K029	dental caries, unspecified	2302	0.67
J181	lobar pneumonia, unspecified	2166	0.63
I251	chronic ischaemic heart disease: atherosclerotic heart disease	1867	0.54
H269	cataract, unspecified	1627	0.47
C900	multiple myeloma	551	0.16
C509	malignant neoplasm of breast unspecified	394	0.11

5.6 Mental health as a primary diagnosis

Counts of the numbers of patients in each of the four patient groups (NANFA, ARNFA, NAFA and ARFA) whose primary presenting condition according to the HES data was a mental health diagnosis were made and the results are shown in table 26 below. The results show that patients in both of the alcohol categories of patient groups: ARNFAs (13.14%) and ARFAs (8.8%), were much more likely to present with a primary mental health condition than non-alcohol related patient groups: NANFAs (0.36%) and NAFAs (0.31%) and the differences between the groups were statistically significant (χ^2 $p<0.001$).

Table 26: Number and % of patients by group who have a mental health diagnosis as their primary diagnosis, and their corresponding CIPS

	Number of people without a mental health primary diagnosis	**Number of people with a mental health primary diagnosis**	**% of group with a primary mental health diagnosis**	**Number of CIPS relating to a mental health primary diagnosis**	**Total CIPS**
NANFA	308,969	1,197	0.36	1,434	374,023
ARNFA	4,547	688	13.14	853	6,858
NAFA	49,167	151	0.31	760	349,807
ARFA	1,730	167	8.80	763	10,130
Total	**364,413**	**2,203**	**0.60**	**3,810**	**740,818**

A more detailed analysis of the types of condition that ARFAs presented with is shown in table 27 below. Six of the most common conditions related to alcohol. Excluding alcohol related conditions shows that the 5 most common primary presenting mental health diagnoses (and their ICD10 diagnosis codes) for ARFAs were:

- Depressive episode (F329);
- Anxiety disorder (unspecified) (F419);
- Delirium unspecified (F059);
- Unspecified dementia (F03X); and
- Bipolar affective disorder (F319).

Table 27: Most common mental health primary diagnoses for ARFAs

ICD10	Description of diagnosis	CIPS count
F103	withdrawal from alcohol	309
F100	acute intoxication from alcohol	266
F102	alcohol dependence syndrome	28
F329	depressive episode	25
F101	harmful use of alcohol	24
F104	withdrawal from alcohol with delerium	14
F419	anxiety disorder (unspecified)	12
F059	delerium unspecified	11
F106	amnesic syndrome due to alcohol	7
F03X	unspecified dementia	<5
F209	schizophrenia, unspecified	<5
F319	bipolar affective disorder, unspecified	<5
F410	panic disorder	<5
F113	withdrawal state from opioids	<5
F402	specific (isolated) phobia	<5
F99X	mental disorder, not otherwise specified	<5

5.6.1 Alcohol diagnosis by gender for ARFAs

This section analyses whether there is a difference between the number and type of alcohol diagnoses for male and female ARFAs. The total number of alcohol related diagnoses were calculated per ARFA patient and frequencies are shown in table 28 below. As demonstrated, more than half of all ARFAs had more than 1 alcohol related diagnosis. The median number of alcohol related diagnoses per person for both males and females is 2, and 30.3% of males and 26.5% of females have more than three alcohol related diagnoses.

Table 28: Number of alcohol related diagnoses per patient amongst ARFAs, by gender.

	Total number of alcohol diagnoses per person							Total	Median
	1	2	3	4	5	6	7+		
Female	247	138	65	42	21	9	2	524	2
Male	627	329	210	114	58	23	12	1373	2

Analysis of alcohol diagnosis by gender for ARFAs (see table 29 below) shows the most frequent alcohol diagnoses for ARFA males were dependence syndrome (349 cases, 25.4% ARFA males), harmful use of alcohol (251 cases, 18.3% males) and alcoholic cirrhosis of the liver (140 cases, 10.2% males). For ARFA females, the most frequent alcohol diagnoses were also dependence syndrome (139 cases, 26.5% females), harmful use of alcohol (75 cases, 14.31% females) and alcohol cirrhosis of the liver (59 cases, 11.26% females).

Table 29: Frequency of alcohol related diagnosis amongst ARFAs by gender

Alcohol diagnosis and ICD10 code	**Male (%) N=1373**	**Female (%) N=524**	**χ^2 (1, N=1897) p value**
F100 acute intoxication	116 (8.45)	44 (8.40)	0.971
F101 harmful use	251 (18.28)	75 (14.31)	0.041
F102 dependence syndrome	349 (25.42)	139 (26.53)	0.622
F103 withdrawal state	117 (8.52)	35 (6.68)	0.186
F104 delirium	<5 (<0.36)	<5 (<0.95)	0.366
F105 psychotic disorder	<5 (<0.36)	<5 (<0.95)	0.284
F106 amnesic syndrome	7 (0.51)	<5 (<0.95)	0.516
F107 residual and late onset psychotic disorder	5 (0.36)	<5 (<0.95)	0.548
F108 other mental and behavioural disorders due to alcohol	0	0	-
F109 unspecified mental and behavioural disorders due to alcohol	<5 (<0.36)	<5 (<0.95)	0.825
K700 alcohol fatty liver disease	15 (1.09)	6 (1.15)	0.922
K701 alcoholic hepatitis	21 (1.53)	17 (3.24)	0.017
K702 alcoholic fibrosis and sclerosis of the liver	<5 (<0.36)	<5 (<0.95)	0.825
K703 alcohol cirrhosis of the liver	140 (10.20)	59 (11.26)	0.499
K709 alcoholic liver disease, unspecified	73 (5.32)	28 (5.34)	0.982
T510 toxic effect of ethanol	19 (1.38)	23 (4.39)	0.000
T511 toxic effect of methanol	0 (0)	0 (0)	-
T519 toxic effect of alcohol unspecified	0 (0)	0 (0)	-
E244 alcohol-induced pseudo-Cushing's syndrome	0 (0)	0 (0)	-
G312 degeneration of nervous system due to alcohol	8 (0.58)	<5 (0.95)	0.267
G621 alcoholic polyneuropathy	<5 (<0.36)	0 (0)	0.284
G721 alcoholic myopathy	0 (0)	0 (0)	-
I426 alcoholic cardiomyopathy	5 (0.36)	0 (0)	0.167
K292 alcoholic gastritis	10 (0.73)	<5 (<0.95)	0.713
K860 chronic pancreatitis (alcohol induced)	27 (1.97)	10 (1.91)	0.935
X45 accidental poisoning by and exposure to alcohol	<5 (<0.36)	<5 (0.95)	0.316

The only diagnoses which showed statistically significant difference ($p<0.05$) between males and females were F101 harmful alcohol use where 18.28%

males affected versus 14.31% females (p=0.041), T510 toxic effect of ethanol 4.39% females versus 1.38% males (p<0.001), and K701 alcoholic hepatitis 3.24% females versus 1.53% males (p=0.017).

5.7 Comparison of comorbidities by patient group

This section compares counts of comorbidities between groups, using firstly a simple count, then secondly application of the Charlson comorbidity index. The mean number of comorbidities per patient, for each of the four patient groups are shown in table 30 below.

Table 30: Mean number of co-morbidities per patient within each of the four patient groups

Patient group	Mean number of co-morbidities	P value (ARFA as reference group)
NANFA	1.83	P<0.001
ARNFA	3.88	P=0.001
NAFA	2.17	P<0.001
ARFA	4.07	reference

Differences between the mean number of comorbidities for each of the patient groups was anlaysed using ANOVA. The differences between means was significant F (3,329234)=3655.75, p<0.001. 3.2% of the variation in mean number of comorbidities was explained by differences in patient groups (r^2 = 0.032).

5.7.1 Analysis of comorbidities using the Charlson comorbidity score

Charlson comorbidity scores were compared for each of the 4 patient groups for South London. Table 31 below shows the frequency of patients with each of the Charlson weightings among the 4 groups. ARFAs have the highest % prevalence of comorbid liver disease (2.9% of ARFAs scored 3 amongst the 4 groups) and the highest proportion of patients with any comorbidities (22% patients scoring 1,2,3 or 6).

Table 31: Frequency of Charlson comorbidity index scores for each of the four patient groups

	NANFA	**ARNFA**	**NAFA**	**ARFA**
0	292,704 (94.4)	4,567 (87.4)	38,711 (78.5)	1,480 (78.0)
1	11,047 (3.6)	504 (9.6)	2,616 (5.3)	265 (14.0)
2	5,812 (1.9)	68 (1.3)	7,248 (14.7)	90 (4.7)
3	165 (0.05)	82 (1.6)	56 (0.1)	55 (2.9)
6	438 (0.1)	5 (0.1)	687 (1.4)	7 (0.4)
Total	**310,166**	**5,235**	**49,318**	**1,897**

Calculation of a weighted average score for each of the four groups was calculated by multiplying the number of patients in each weighting category by the weighting, adding the totals for each weight category together, then calculating a mean by dividing the product of all categories by the total number of people in each of the 4 population groups, to give a weighted average for each. NAFAs had the highest weighted average score of 0.43, followed by ARFAs at 0.34, ARNFAs at 0.17 and NANFAs at 0.08.

A more detailed breakdown of the prevalence of each of the comorbidities included within the Charlson comorbidity scores assigned by patient group (number of cases per 1000) is shown in table 32 below and key findings included:

- higher prevalence of cerebrovascular disease amongst alcohol-related admissions (16.62 per 1000 amongst ARNFAs and 14.23 for ARFAs compared to 9.72 per 1000 for all South London hospital admissions);
- markedly higher prevalence of COPD amongst ARFAs (30.57 per 1000) than all South London hospital admissions as a whole (8.74 per 1000);

- higher prevalence of peptic ulcer disease amongst alcohol-related admissions (9.49 per 1000 for ARFAs and 7.83 per 1000 for ARNFAs compared to 2.20 per 1000 for all South London hospital admissions as a whole;
- markedly higher prevalence of mild liver disease amongst ARFAs (50.08 per 1000) and ARNFAs (36.29 per 1000) than all South London hospital admissions as a whole (1.67 per 1000);
- markedly higher prevalence of moderate/severe liver disease amongst ARFAs (28.99 per 1000) and ARNFAs (15.66 per 1000) than all South London hospital admissions as a whole (0.98 per 1000);
- higher prevalence of diabetes amongst ARFAs (13.71 per 1000) than for all South London hospital admissions as a whole (2.48 per 1000);
- higher prevalence of cancer (44.28 per 1000) for ARFAs than for all South London hospital admissions as a whole (31.50 per 1000).

Table 32: Prevalence of co-morbidities by 4 population sub-groups within South London. Cells show total number of persons with each disease type and (corresponding disease rate per 1000 people in each sub-group)

Disease type	**NANFA**	**ARNFA**	**NAFA**	**ARFA**	**Total**
Acute MI	1366 (4.40)	27 (5.16)	249 (5.05)	10 (5.27)	1652 (4.51)
Congestive heart failure	1208 (3.89)	38 (7.26)	361 (7.32)	21 (11.07)	1628 (4.44)
Peripheral vascular disease	651 (2.10)	8 (1.53)	219 (4.44)	8 (4.22)	886 (2.42)
Cerebrovascular disease	3036 (9.79)	87 (16.62)	415 (8.41)	27 (14.23)	3565 (9.72)
dementia	325 (1.05)	5 (0.96)	68 (1.38)	<5 (<2.11)	398 (1.09)
COPD	2460 (7.93)	68 (12.99)	617 (12.51)	58 (30.57)	3203 (8.74)
Rheumatoid disease	394 (1.27)	0 (0)	374 (7.58)	<5 (<2.11)	768 (2.09)
Peptic ulcer disease	602 (1.94)	41 (7.83)	146 (2.96)	18 (9.49)	807 (2.20)
Mild liver disease	289 (0.93)	190 (36.29)	40 (0.81)	95 (50.08)	614 (1.67)
Diabetes	716 (2.31)	40 (7.64)	127 (2.58)	26 (13.71)	909 (2.48)
Diabetes with complications	155 (0.50)	<5 (<0.76)	61 (1.24)	<5 (<2.11)	216 (0.59)
Hemi/para-plegia	87 (0.28)	<5 (<0.76)	24 (0.49)	0 (0)	111 (0.30)
Renal disease	331 (1.07)	<5 (<0.76)	999 (20.26)	5 (2.64)	1335 (3.64)
Cancer	5239 (16.89)	60 (11.46)	6164 (124.98)	84 (44.28)	11547 (31.50)
Moderate/severe liver disease	165 (0.53)	82 (15.66)	56 (1.14)	55 (28.99)	358 (0.98)
Metastatic cancer	438 (1.41)	5 (0.96)	687 (13.93)	7 (3.69)	1137 (3.10)
Total persons	**310,166**	**5,235**	**49,318**	**1,897**	**366,616**

5.7.2 Comparison of risk of comorbidities for ARFAs versus all other groups

In the following analysis the prevalence of a selection of ICD10 coded diagnoses were compared between 2 groups: ARFAs and non-ARFAs (ARNFAs, NAFAs and NANFAs combined). The strength of the significance of the relationship was tested using χ^2.

No significant difference in the prevalence of TB, STIs, musculoskeletal conditions, genito-urinary conditions, digestive problems or accidents involving vehicles was shown between ARFAs and non-ARFAs. However, there was a significant difference between ARFAs and non-ARFAs for a number of other diagnoses and these results are summarised in table 33 below, with relative risks calculated for each diagnostic group. The results show that:

- ARFAs are 9 times more likely to attend for self-harm injury than non-ARFAs, though this affects a relatively small proportion of the ARFA population as a whole (3.74% or 71 people).
- ARFAs are almost twice as likely to be affected by circulatory disease (46.13% ARFAs) than non-ARFAs;
- ARFAs are more than twice as likely to be affected by respiratory conditions (28.36% ARFAs) than non-ARFAs;
- ARFAs are twice as likely to have diabetes mellitus than non-ARFAs (17.08%);
- ARFAs are 1.45 times more likely to have mental health co-morbidities (16.45%) than non-ARFAs.

Table 33: Relative risks of co-morbidities amongst ARFAs compared to non-ARFAs in South London

Comorbidity (ICD10 group)	No. ARFA cases	Absolute risk ARFAs (%)	Absolute risk non-ARFAs (%)	Risk difference ARFA vs non-ARFA (p-value)	Relative risk (ARFA vs non-ARFA)
Self harm	71	3.74	0.4	<0.001	9.35
Assault	15	0.79	0.24	<0.001	3.29
Nutritional anaemias	61	3.22	1.24	<0.001	2.60
Neurological disorders	258	13.6	6.02	<0.001	2.26
Respiratory conditions	538	28.36	13.36	<0.001	2.12
Malnutrition	17	0.9	0.44	<0.005	2.05
Diabetes mellitus	324	17.08	8.39	<0.001	2.04
Circulatory system disorders	875	46.13	26.7	<0.001	1.73
Dermatological conditions	133	7.01	4.29	<0.001	1.63
Cancers attributable to alcohol	41	2.16	1.37	<0.01	1.58
Mental health conditions	312	16.45	11.36	<0.001	1.45
All cancers/neoplasms	125	6.59	5.37	<0.05	1.23

5.8 Summary

This chapter documented the physical and mental health conditions that ARFAs presented to hospital with, and analysed whether ARFAs are any more complex than any other patient group in terms of their comorbidities and disease status.

In South London during 2013/14 ARFAs predominantly presented to hospital with conditions wholly attributable to alcohol: 3 of the top 5 presentations to hospital for ARFAs include alcohol withdrawal, alcoholic cirrhosis of the liver and acute intoxication from alcohol. Together these 3 presentations accounted for 9.3% of all admissions (CIPS) for ARFAs. In terms of the most common conditions that ARFAs presented with, physical health conditions (including renal failure, UTI, COPD, chest pain, tendency to fall, syncope and collapse) outweighed the number of presentations where a mental health condition was the primary diagnoses.

The most commonly presenting primary diagnoses for ARFAs are similar to those for alcohol-related non-frequent admissions (ARNFAs), though there are more wholly attributable alcohol diagnoses amongst the most common primary diagnoses for ARNFAs than ARFAs. Head injuries are also a common primary cause for alcohol-related non-frequent admissions. Comparing presenting conditions for ARFAs with presenting conditions for non-alcohol related frequent attenders, shows that non-alcohol related frequent attenders most commonly present with physical health conditions, which (in common with ARFAs) include chest pain, kidney disease, UTI and pneumonia. There are no mental health diagnoses among the most commonly primary presenting diagnoses for non-alcohol related frequent attenders.

There is a stark contrast between the proportion of alcohol-related attenders (frequent- and non-frequent) who present with a mental health condition as their primary diagnoses compared to other attenders. The odds ratios for ARFAs and ARNFAs presenting with a primary mental health diagnosis are OR 17.2 (95% CI 14.6-20.3) for ARFAs and OR 15.8 (95% CI 14.3-17.2) for ARNFAs. The five most common primary presenting mental health diagnoses for ARFAs are depressive episode, anxiety disorder, delirium (not specified as being attributed to alcohol) and bipolar affective disorder.

A simple count of the total number of wholly attributable alcohol related diagnoses revealed that ARFAs on average each have 2 different wholly attributable alcohol diagnoses and almost one third of male ARFAs and more than a quarter of female ARFAs have more than three alcohol related diagnoses, suggesting that ARFAs have entrenched drinking problems. The most frequent alcohol diagnoses for ARFA males were dependence syndrome (25.4%), harmful use of alcohol (18.3%) and alcoholic cirrhosis of the liver (10.2%). The same diagnoses were also the most common for females, with slightly different prevalence: dependence syndrome (26.5%), harmful use of alcohol (14.31%) and alcoholic cirrhosis of the liver (11.26%). The only diagnoses which showed significant difference ($p<0.05$) between males and females were harmful use of alcohol, where more males were affected than females; and toxic effect of ethanol and alcoholic hepatitis which affected more females than males.

Looking next at the total number of comorbidities and severity of comorbidities experienced by ARFAs compared to other groups revealed that ARFAs have significantly more comorbidities than ARNFAs, NAFAs and NANFAs ($p<0.001$). Application of the Charlson comorbidity index to the four patient groups showed ARFAs to have the highest incidence of co-morbid liver disease and confirmed the ARFA group to have the highest proportion of patients with any co-morbidities. More detailed analysis of relative risk of comorbidities measured within the Charlson index showed ARFAs to have an almost 3-fold increase in prevalence of congestive heart failure compared to all other admissions; 46% higher prevalence cerebrovascular disease; higher prevalence of COPD, peptic ulcer disease, mild and severe liver disease, diabetes and cancers compared to other admissions.

Finally, analysis of a wider range of comorbidities than provided by the Charlson comorbidity index was undertaken, comparing prevalence of conditions amongst ARFAs to all non-ARFAs (ARNFAs, NANFAs and NAFAs). The results showed ARFAs to be significantly more likely than non-ARFAs to be victims of assault; and more likely than non-ARFAs to present with self-harm and mental health comorbidities; as well as circulatory disease, neurological disorders, nutritional anaemias, respiratory conditions and diabetes. ARFAs were also more likely to present with cancers attributable to alcohol as well as other cancers.

In summary, although, ARFAs and ARNFAs are collectively more likely to present with a primary mental health condition than other (non-alcohol related) hospital users, ARFAs are still more likely to present with a primary physical health condition than a mental health condition. Most ARFAs have more than one alcohol-related diagnosis, and there appears to be no difference between males and females in terms of the most common alcohol-related diagnoses. Application of a comorbidity index showed that ARFAs experience more comorbidities and more severe comorbidities than other patient groups.

As described in chapter 2 (systematic review), the literature recognises that ARFAs are a complex group of patients with both physical and mental health comorbidities. What this study perhaps now adds in practical clinical terms, is that a patient presenting with a primary physical ill-health diagnosis and history of alcohol use could be an ARFA, even though they are not presenting with a chronic wholly attributable alcohol diagnosis as their primary presenting complaint. These findings also confirm that ARFAs are complex patients, often with more than one alcohol-related problem and a wider range of comorbidities, which are more severe, than for other patient groups.

6 Predictors of alcohol related frequent attendance in England in 2015/16

6.1 Background

Previous literature shows that moderate to excessive drinking, moderate to heavy tobacco use, socio-economic status, and marital status are all strong predictors of first admission to hospital for alcohol (Lawder et al, 2011). The systematic review in this thesis identified a number of characteristics associated with readmissions or multiple admissions for alcohol: younger age of onset of first problem drinking, source of referral to alcohol treatment, greater number of arrests due to alcohol, marriage breakdown (Holland and Evenson, 1984); drinking patterns and behaviours and ability to return to work (Fagan et al, 2014; Ponzer et al, 2002); biochemical markers (Ponzer, Johansson and Bergman, 2002); established chronicity, younger age, living alone (Siegel, Alexander and Lin, 1984); psychiatric co-morbidity, less stable family background and unemployment (Slater and Linn, 1982). Previous treatment for alcohol dependence was also cited as a predictor (Booth et al, 1991). Of these characteristics, age, psychiatric comorbidity and presence of a chronic alcohol diagnosis are recorded within HES. No previous studies have specifically looked at predictors of frequent admissions for alcohol-related conditions.

Studies using local data presented in earlier chapters of this thesis (chapters 4 and 5) have shown that:

- Age, gender and income deprivation are all predictors of alcohol-related frequent attending.
- Alcohol related frequent attenders have more comorbidities than other patient groups.

So far this latter finding has only been analysed in terms of total number of comorbid conditions in addition to primary diagnosis, with nominal weights attributed to comorbid diagnoses using the Charlson comorbidity index (chapter 5). Additional analysis showed that alcohol-related frequent attenders, while still more likely to present with a physical comorbidity, had a higher prevalence of mental health comorbidities than other patient groups. As part of the analyses presented in this chapter, the presence of a mental health diagnosis and its influence on patient outcome (in terms of alcohol-related and frequent attendance) will be explored.

6.2 Aims of the study

This chapter will address the following questions:

1. Do different patterns of use of health services (eg number of alcohol admissions, number of inpatient admissions) predict whether patients will become an ARFA vs ARNFA vs NAFA vs NANFA, whilst controlling for demographic charcteristics including age, gender and income?
2. Does having a mental health diagnosis or a chronic alcohol diagnosis predict whether patients will become ARFAs, ARNFAs, NAFAs or NANFAs?
3. Does the likelihood of future transition to a particular group vary with time?

In particular, the studies described in this chapter test the hypothesis that multiple medical and socio-demographic characteristics can predict transition to alcohol related frequent attendance.

6.3 Sample

For the longitudinal analysis, a cohort of patients was selected from all adult patients aged 18 years or over who were treated in English hospitals between 01/04/2015 and 31/03/2016, whose hospital episode data had been captured, was complete and valid on NHS Digital's Hospital Episodes Statistics database. Records of admissions for the selected patients from the previous 4 years (01/04/2011-31/03/2015) were included. Sampling is shown in table 34 below and is described in chapter 3. The final 2015/16 cohort consisted of 490,384 patients with 4,605,260 consultant episodes across the five year span.

Table 34: Summary of the 2015/16 cohort and sampling for analysis by 4 patient groups

Patient group	No. of patients included in the sample	% of all patients in the 2015/16 national dataset included in the sample
ARFAs	54,369	100
ARNFAs	136,015	100
NAFAs	150,000	12.6
NANFAs	150,000	2.4
Total	490,384	6.41

A further round of sampling took place to allow analysis between 2 dichotomous groups: ARFAs versus non-ARFAs. All new ARFAs (no history of being an ARFA prior to 2015/16) were included as the study group and the single control group consisted of ARNFAs, NAFAs and NANFAs, in numbers proportional to their representation within the entire national sample ie 2%, 16% and 82% resepectively.

An overview of sampling for both analyses is shown below in figure 11.

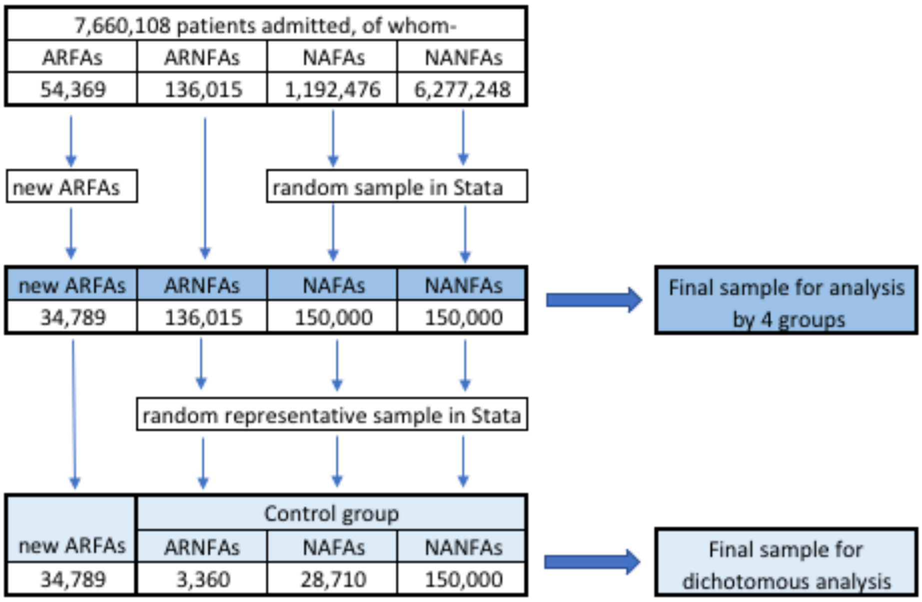

Figure 11: Overview of selecting samples from the 2015/16 cohort of adult patients admitted to hospital in England

6.4 Analyses

Which factors predict becoming an ARFA in 2015 and what is the pattern of health service use prior to becoming an ARFA?

This analysis included patients selected from the 2015/16 data, as described in table 10, referred to as the 2015/16 cohort. Hospital admission records between 2011/12 -2015/16 for all ARFAs identified in England on the basis of their alcohol and frequent attending status during 2015, were analysed according to whether they were an ARFA for the first time in 2015/16 or had had a previous alcohol admission in 2011/12-2014/15 or been a frequent attender in 2011/12-2014/15.

The patterns of hospital admissions prior to 2015/16 were determined as were basic demographics (age, gender, income level) along with the nature of alcohol diagnoses and other comorbidities, using the following newly created variables:

- presence of a chronic alcohol diagnosis (including ICD10 codes E244, G312, G621, G721, I426, K292, K700, K701, K702, K703, K704, K709, K852, K860);
- having more than 3 alcohol admissions across all years;
- having more than 3 inpatient admissions across all years;
- having more than 2 alcohol admissions for diagnoses which were wholly attributable to alcohol (WAAD) in 1 year; and
- presence of a mental health diagnosis other than an alcohol-related condition.

Findings for ARFAs were compared to the 3 control groups (ARNFAs, NANFAs, NAFAs), with relative risks calculated showing the likelihood of being an alcohol attender (ARFA or ARNFA) or a frequent attender (ARFA or NAFA), compared to being a non-alcohol non-frequent attender (NANFA). Confidence intervals and p-values were calculated for each relative risk.

Does the likelihood of future transition to ARFA vary with time?

The analysis included patients from the 2015/16 data, as described in table 10, comparing the odds ratio of becoming an ARFA in 2015 versus not becoming an ARFA, on the basis of variables populated with data from the successive years 2011-2014 combined. Patients were categorised dichotomously as to whether they were a new ARFA in 2015 or not i.e. became ARFAs for the first time in 2015/16.

Logistic regression on the dependent binary variable “new ARFA in 2015/not an ARFA in 2015”, was undertaken using the independent variables:

- age at start of admission,
- gender,
- IMD income score: the proportion of the population in an area experiencing deprivation relating to low income;
- presence of a chronic alcohol diagnosis (WAAD);

- having more than 3 alcohol admissions across all years;
- having more than 3 inpatient admissions across all years;
- having more than 2 alcohol (WAAD) admissions in 1 year;
- presence of a mental health diagnosis other than an alcohol-related condition.

Odds ratios were calculated for the binary dependent variable new ARFA in 2015/16, versus all other categories of patient combined (ARNFA, NAFA and NANFA), using different combinations of data from the years 2011/12 -2014/15 (shown in table 35 below) and also using individual years' data to investigate whether the odds ratios (while controlling for all other factors) changed at varying time points prior to becoming an ARFA.

Table 35: Summary of data included in comparison of odds ratios

	2011/12	2012/13	2013/14	2014/15	2015/16
1 year prior	✓	✓	✓	✓	
2 years prior	✓	✓	✓		
3 years prior	✓	✓			
4 years prior	✓				

Results are presented as odds ratios with associated confidence intervals and p-values calculated.

6.5 Results

6.5.1 Pattern of health service use prior to becoming an ARFA: a 5-year retrospective study of ARFAs identified in 2015/16

Of the 54,551 ARFAs in the 2015/16 cohort, 19762 patients were ARFAs during at least 1 year between 2011/12 and 2014/15 before being an ARFA during 2015/16, that is to say, 36.2% of ARFAs in 2015 had previous history of being an ARFA. As shown in figure 12 below, 5841 patients (10.7%) from the 2015/16 ARFA cohort were traced back to being ARFAs each and every year as far back as 2011.

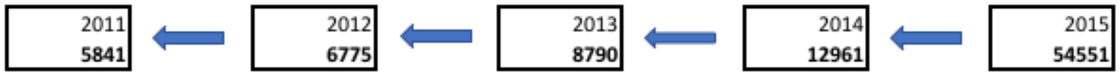

Figure 12: Number of ARFAs in the 2015/16 cohort who were also ARFAs in all of the previous years

41,590 patients (76.2%) from the 2015 ARFA cohort had not been ARFAs in the preceding year, 2014/15. 34,789 patients from the 2015 ARFA cohort had never been an ARFA in any year between 2011/12 and 2014/15 prior to becoming an ARFA in 2015/16 ie. 63.8% of patients from the 2015 ARFA cohort were ARFAs for the first time in 2015/16.

Which factors predict becoming an ARFA?

An analysis using a combination of variables: age; gender; income deprivation; previous alcohol admission; chronic alcohol diagnosis; non-alcohol admission; total number of alcohol admissions; total number of non-alcohol-related hospital admissions; more than two alcohol admissions; and having a mental health diagnosis; was undertaken to calculate odds ratios for being a new ARFA in 2015/16. Relative risks of being an ARFA vs NANFA: ARNFA vs NANFA; and NAFA vs NANFA were calculated using all four years of data combined (2011/12 -2014/15). Results are shown in table 36 below.

Table 36: Results of multinomial logistic regression showing relative risk ratios for each patient status group compared to non-alcohol non-frequent attenders (base)

	Relative risk ratios (95% CIs and p values) of status in 2015/16 based on presence of each factor 2011/12-2014/15, compared to being a non-alcohol non-frequent attender		
	New ARFA	ARNFA	NAFA
Age at start of admission [startage, years]	0.991 (0.990-0.992) p<0.001	0.980 (0.980-0.980) p<0.001	1.011 (1.011-1.012) p<0.001
Male [1=male ,0=female]	2.847[a] (2.761-2.935) p<0.001	2.780[a] (2.735-2.865) p<0.001	1.042 (1.023-1.061) p<0.001
Income deprivation [imd04i]	4.780[a] (4.249-5.422) p<0.001	4.656[a] (4.233-5.120) p<0.001	1.692 (1.562-1.834) p<0.001
Ever had an alcohol admission [1=YES, 0=NO]	0.818[a] (0.575-1.163) p=0.263	1.691 (1.219-2.345) p<0.001	0.760[a] (0.478-1.205) p=0.243
Having a chronic alcohol diagnosis [1=YES, 0=NO]	11.630 (10.278-13.160) p<0.001	10.984 (9.749-12.375) p<0.001	0.633 (0.534-0.749) p<0.001
Having a non-alcohol related admission [1=YES, 0=NO]	0.096 (0.085-0.109) p<0.001	0.250 (0.225-0.277) p<0.001	1.101 (0.967-1.253) p=0.147
>=3 alcohol admission (across all years) [1=YES, 0=NO]	2.015 (1.817-2.236) p<0.001	6.582 (6.025-7.190) p<0.001	0.920 (0.830-1.020) p=0.113
>=3 inpatient admissions (across all years, any cause) [1=YES, 0=NO]	1.090 (1.081-1.101) p<0.001	0.920 (0.912-0.929) p<0.001	1.218 (1.211-1.225) p<0.001
Having 2 admissions within 1 year, but not 3 or more [1=YES, 0=NO]	0.853[a] (0.694-1.048) p=0.129	0.383 (0.316-0.463) p<0.001	0.876[a] (0.683-1.124) p=0.298
Having any mental health diagnosis (excluding alcohol related) [1=YES, 0=NO]	2.822[a] (2.725-2.923) p<0.001	2.729[a] (2.656-2.804) p<0.001	1.061 (1.034-1.088) p<0.001

[a] Note relative risks with the same superscript in each row are not significantly different from each other at p>0.05

Using results from 4 years of data combined (2011/12, 2012/13, 2013/14, 2014/15) and controlling for all other factors:

- men are almost three times as likely to become ARFAs as females (RR 2.847 p<0.001), however relative risk was not significantly higher than for ARNFAs;
- individuals living in areas experiencing highest income deprivation are almost five times as likely to become ARFAs as those living in less deprived areas (RR 4.780 p<0.001), however relative risk were not significantly higher than for ARNFAs;
- having had a previous alcohol admission, or indeed multiple previous alcohol admissions, was more strongly associated with becoming an ARNFA than becoming an ARFA;
- individuals with a chronic alcohol diagnosis are almost 12 times more likely to become an ARFA than those without a chronic alcohol diagnosis (RR 11.63 p<0.001) and relative risk was higher for becoming an ARFA than an ARNFA;
- those patients with any mental health diagnosis other than a wholly attributable alcohol diagnosis were three times as likely to be ARFAs in 2015/16 as patients who had no mental health diagnosis (RR 2.822 p<0.001), however a this relative risk was significantly different to that seen for becoming an ARNFA;
- individuals with multiple cumulative alcohol admissions (across all years) were 2 times more likely to become an ARFA than those with fewer cumulative alcohol admissions (RR 2.02 p<0.001); and
- with each additional year of age, odds of being an ARFA in 2015/16 reduced by less than 0.07% (RR 0.99 p<0.001).

In summary, factors that were found to be strongly associated with becoming a new ARFA within four years were: being male, living in an area charactersied by low income deprivation score, having a chronic alcohol diagnosis, accumulating multiple admissions for alcohol-related causes over time and having a mental health diagnosis. However, all these factors were also associated with becoming an ARNFA during the same period. Age, total number of inpatient admissions and having a chronic alcohol diagnosis resulted in a greater relative risk for being an ARFA than a ARNFA.

Do odds ratios that predict transition to ARFA change over time?
Comparing odds ratios and confidence intervals for the different combinations of inpatient data years over time in table 37 showed that accumulating a greater number of alcohol related admissions over time was more strongly predictive of becoming an ARFA 1 year prior than 4 years prior to being a new ARFA. This could be because over a longer period of time, there is more time for more admissions to accumulate (1 year prior data consists of years 11/12, 12/13, 13/14 and 14/15 combined whereas at 4 years prior, only 1 year's of data was included: it did not include the three previous years' data) compared to the 4 years' prior data which was effectively censored. At 3 years prior to becoming an ARFA, having more than 3 alcohol admissions appeared to reduce the odds of becoming an ARFA, ie conferred a protective effect.

Income deprivation and having a chronic alcohol diagnosis became less strongly predictive of being an ARFA 1 year prior compared to 4 years prior to becoming an ARFA suggesting that these factors are good early predictors. The reduction in odds ratios in the years nearer to becoming an ARFA could also be reflective of the nature of the chronic conditions being detected, for example, alcoholic gastritis may be less likely to lead to multiple hospital admissions during a year than chronic pancreatitis.

Total number of inpatient admissions, having a mental health diagnosis, being male and age remained relatively static predictors of becoming an ARFA and 1 and 4 years prior to new ARFA status.

The logistic regression was repeated but this time with single years' data populating the independent variables and the results are shown in table 38. Age, gender and having a mental health diagnosis remain as relatively static indicators of outcome across the years. Income deprivation and having a chronic alcohol diagnosis still remain more predictive of ARFA status in earlier years than later years, but odds ratios for both these variables are reduced compared to the data from the combined years. Having more than 3 admissions for any cause in the year prior increased the odds of being an ARFA, however, in earlier years although having more than 3 admissions in year seemed to reduce the chances of being an ARFA these results were not statistically significant. Likewise, having more than 2 admissions for alcohol during the year prior was also a significant factor in becoming an ARFA, but this was not the case in previous years.

The variable "having atleast 1 alcohol admission during the year" was included in the analysis for single years. This indicator appearerd highly predictive of subsequently becoming an ARFA and odds increased in the years approaching becoming an ARFA for the first time. Given that the analysis only included new ARFAs, then this must mean that being an ARNFA is highly predictive of becoming a new ARFA as any patient having an alcohol admission would have to have been classified as either an ARFA or an ARNFA but all ARFAs prior to 2015 were removed from the data.

Comparing the results of the combined years' regression with the individual years' regression suggests that censoring may have inflated the importance that having a chronic alcohol diagnosis has in becoming an ARFA, but it remains a significant early predictor. This also seems to be the case for the predictor "having 2 or more alcohol admissions in a year": in the combined data there are more years in which a person could have had 2 or more admissions for alcohol compared to single years alone.

Table 37: Results of logistic regression- odds ratio of being an ARFA in 2015, based on combined years' admissions data 2, 3 and 4 years before first becoming an ARFA

Variable	Odds ratios (95% CIs and p values) of being a new ARFA based on admissions data 1, 2, 3 and 4 years before first becoming an ARFA			
	1 years prior 2011/12-2014/15	2 years prior 2011/12-2013/14	3 years prior 2011/12-2012/13	4 years prior 2011/12 only
Age at start of admission [startage, years]	0.985 (0.984-0.985) p<0.001	0.985 (0.984-0.986) p<0.001	0.985 (0.984-0.986) p<0.001	0.984 (0.983-0.985) p<0.001
Male [1=male ,0=female]	2.282 (2.733-2.903) p<0.001	2.881 (2.789-2.978) p<0.001	2.882 (2.778-2.992) p<0.001	2.808 (2.680-2.942) p<0.001
Income deprivation [imd04i]	4.278 (3.780-4.815) p<0.001	4.871 (4.284-5.539) p<0.001	5.332 (4.611-6.165) p<0.001	5.856 (4.877-7.030) p<0.001
Having a chronic alcohol diagnosis [1=YES, 0=NO]	10.976 (10.044-11.994) p<0.001	10.445 (9.374-11.637) p<0.001	11.819 (10.310-13.548) p<0.001	14.305 (11.566-17.691) p<0.001
>=3 alcohol admission (across all years) [1=YES, 0=NO]	1.826 (1.619-2.061) p<0.001	1.030 (0.880-1.206) p<0.711	0.256 (0.203-0.323) p<0.001	1*
>=3 inpatient admissions (across all years, any cause)	1.429 (1.387-1.471) p<0.001	1.214 (1.175-1.254) p<0.001	1.066 (1.026-1.109) p=0.001	0.818 (0.770-0.868) p<0.001
Having >=2 alcohol admission within 1 year [1=YES, 0=NO]	3.751 (3.405-4.131) p<0.001	4.051 (3.602-4.555) p<0.001	6.475 (5.577-7.518) p<0.001	6.675 (5.547-8.033) p<0.001
Having any mental health diagnosis (excluding alcohol related) [1=YES, 0=NO]	2.080 (2.011-2.151) p<0.001	2.089 (2.013-2.167) p<0.001	2.078 (1.992-2.168) p<0.001	2.078 (1.968-2.193) p<0.001

*this finding is based on 1 year of data only and therefore to have had 3 or more alcohol admissions in 1 year would automatically characterize the person as an ARFA.

Table 38: Results of logistic regression- odds ratio of being an ARFA in 2015, based on individual years' admissions data 2, 3 and 4 years before first becoming an ARFA

	Odds ratios (95% CIs and p values) of being a new ARFA based on admissions data 1, 2, 3 and 4 years before first becoming an ARFA			
	1 years prior 2014/15	2 years prior 2013/14	3 years prior 2012/13	4 years prior 2011/12 only
Age at start of admission [startage, years]	0.987 (0.986-0.988) p<0.001	0.988 (0.987-0.990) p<0.001	0.989 (0.987-0.990) p<0.001	0.987 (0.986-0.988) p<0.001
Male [1=male ,0=female]	2.382 (2.288-2.481) p<0.001	2.549 (2.438-2.664) p<0.001	2.581 (2.463-2.705) p<0.001	2.510 (2.391-2.635) p<0.001
Income deprivation [imd04i]	3.793 (3.217-4.472) p<0.001	3.894 (3.257-4.656) p<0.001	3.736 (3.097-4.508) p<0.001	4.095 (3.376-4.968) p<0.001
Having atleast 1 alcohol admission during the year [1=YES, 0=NO]	21.050 (19.526-22.693) p<0.001	16.139 (14.870-17.517) p<0.001	13.484 (12.361-14.710) p<0.001	12.390 (11.308-13.575) p<0.001
Having a chronic alcohol diagnosis [1=YES, 0=NO]	1.778 (1.523-2.075) p<0.001	1.592 (1.332-1.904) p<0.001	1.902 (1.555-2.327) p<0.001	2.031 (1.629-2.532) p<0.001
>=3 inpatient admissions (any cause) [1=YES, 0=NO]	1.125 (1.074-1.179) p<0.001	0.982 (0.931-1.036) p=0.506	0.962 (0.909-1.019) p=0.191	0.954 (0.898-1.015) p=0.134
Having >=2 alcohol admission within 1 year [1=YES, 0=NO]	1.267 (1.094-1.467) p=0.002	0.967 (0.819-1.141) p=0.689	0.904 (0.753-1.086) p=0.280	0.868 (0.716-1.054) p=0.153
Having any mental health diagnosis (excluding alcohol related) [1=YES, 0=NO]	2.604 (2.491-2.723) p<0.001	2.681 (2.553-2.815) p<0.001	2.539 (2.408-2.676) p<0.001	2.396 (2.265-2.534) p<0.001

6.6 Summary

This study aimed to test the hypothesis that multiple medical and socio-demographic characteristics can predict transition to alcohol related frequent attendance.

Results showed that almost two-thirds of ARFAs in 2015/16 had never been an ARFA before. 10% of the 2015/16 cohort had been ARFAs every year for the previous four years and this gives insight in to the chronicity of the problem and consequent scale of burden. This will be explored more in further chapters.

The results presented show that gender, income deprivation, having a chronic alcohol diagnosis, more than one admission in a year, and having a concomitant mental health diagnosis (other than a wholly atrributable alcohol diagnosis) are all associated with becoming an alcohol-related frequent attender. However, all these factors were also associated with becoming an alcohol related non-frequent attender during the same period and as such these factors could not distinguish between a person becoming an alcohol related frequent or non-frequent attender. Nevertheless, age, total number of inpatient admissions and having a chronic alcohol diagnosis resulted in a greater relative risk ie were more strongly associated with being an ARFA than a ARNFA.

By comparing odds ratios over time for becoming a new ARFA, it was hypothesised that certain variables would be stronger and earlier predictors of becoming an ARFA than others. Analysis using different combinations of inpatient data years showed that the only odds ratios which were significantly different between 2011/12 and 2011/12-2013/14 when all years' data were combined were those for age at start of admission, being income deprived, having a chronic alcohol diagnosis, and having 1 or multiple alcohol admissions over time. As there was little change in odds ratios with time for all the other variables, this suggests that predictors of becoming a new ARFA are evident as early as 4 years prior to being first identified as an ARFA. But we know from earlier findings in this chapter that these same four variables are unlikely to clearly distinguish an ARFA from an ARNFA so using them as a predictive tool in their own right is likely to be unreliable.

Using the same data but analysing the effects of each year's data alone, reduced the effect having a chronic alcohol diagnosis, having more than 2 alcohol admissions in a year and having more than 3 admissions for any cause in a year. This suggests that censoring of data may be an issue: when 4 years of data are combined there is more chance that these variables will be true (or score yes=1) as there are more years of data during which these events could happen; whereas looking at data for 2011 alone, gives less opportunity for these events to happen.

7 Alcohol related frequent attenders: a 5-year longitudinal study of alcohol related liver disease and mortality

7.1 Background

The UK has seen deaths from liver disease increase by over 400% since the 1970s. Whilst death rates from severe alcohol-related liver disease (ARLD) in most other European countries are falling, in the UK in recent years death rates from ARLD have remained relatively static over the same period (WHO, 2014).

ARLD includes the diagnoses: alcoholic fatty liver, alcoholic hepatitis and alcoholic cirrhosis. There is a growing epidemic of liver disease in the UK and ARLD will soon overtake ischaemic heart disease in terms of years of working life lost (Williams et al, 2018). ARLD can take over 10 years to manifest, firstly as alcoholic fatty liver then fibrosis leading to cirrhosis then acute or chronic liver failure, following prolonged exposure to harmful levels of alcohol (Hazeldine, Hydes and Sheron, 2015). Eighty percent of liver disease patients present as an emergency either because of decompensated cirrhosis or alcoholic hepatitis (Hazeldine, Hydes and Sheron, 2015). Every year over 4,000 people in the UK die from cirrhosis and around 700 people each year require a liver transplant to survive .

Cirrhosis is indicative of late stages of chronic progressive liver disease. Patients with cirrhosis but no major complications are said to have compensated cirrhosis. Complications of cirrhosis include variceal bleeding, ascites, spontaneous bacterial peritonitis, liver cancer, encephalopathy, hepatorenal syndrome or hepatopulmonary syndrome, and patients with these complications are said to have decompensated cirrhosis. Complications are the main cause of death in patients with end-stage liver disease.

Treatment for ARLD includes abstinence: for fatty liver disease the damage may be reversed after 2 weeks. Advanced liver disease, liver failure and decompensated cirrhosis are known as end-stage ARLD because they are largely irreversible (Cox-North et al, 2013). No Food and Drugs Administration (FDA)-approved drug exists for the treatment of alcoholic cirrhosis. Liver transplantation is potentially curative, however few patients are candidates due to clinical and social factors, comorbidity or disease extent.

7.2 Aims of the study

The main aim of this study was to test the hypothesis that ARFAs have poorer long-term health outcomes compared to other hospital users. Outcomes examined included incidence and prevalence of ARLD over 5 years; incidence and prevalence of end-stage ARLD over 5 years; and deaths in hospital measured using survival analysis and Cox regression. Outcomes were compared between ARFAs and other 3 other patient groups: ARNFAs, NAFAs and NANFAs.

7.2.1 Sample

For the longitudinal analysis, a sample of 2011/12 patients were tracked forwards through the data from 2011/12 to 2015/16. Total sample size was based on the largest overall cohort size that could be analysed in practice within Stata v12 MP, with a 1:3 ratio of index group (ARFAs) to each of the controls (ARNFAs, NANFAs, NAFAs) where possible. Details of number of patients in each category included in the sample are given in section 3.11.3 in methods, chapter 3 and summarized in table 39 below. The final 2011/12 cohort consisted of 489,580 patients with 4,740,217 finished consultant episodes.

Table 39: Summary of the 2011/12 cohort and sampling

	No. of patients included in the sample	% of all patients in the 2015/16 national dataset included in the sample
ARFAs	51,934	100
ARNFAs	137,646	100
NAFAs	150,000	13.9
NANFAs	150,000	0.025
Total	489,580	6.81

7.3 Analyses

7.3.1 Incidence and prevalence of alcohol specific liver disease diagnoses

Prevalence of alcohol related liver disease amongst the 2011/12 cohort was measured across the 5 year period to 2011/12-2015/16. Statistical significance of differences amongst prevalence rates were compared across the 4 patient groups using a Chi^2 test.

Incidence of ARLD and end-stage ARLD were also calculated for each of the 4 patient groups and compared. Only patients from the 2011/12 cohort with no incidence of ARLD recorded in the year 2011/12 were included in the analysis. Occurrence of new diagnoses of ARLD and end-stage ARLD between 2012/13 and 2015/16 were counted.

7.3.2 Mortality

This analysis included patients selected from the 2011/12 data, as described in table 40, known as the 2011/12 cohort. For this analysis, patients in the 2011/12 cohort were followed up for four years and death in hospital between 1st April 2011 and 31st March 2016 was the primary outcome measure. Kaplan Meier survival curves were calculated for the four patient groups in the cohort according to their status in 2011/12: ARFAs, ARNFAs, NAFAs and NANFAs. Statistically significant differences between the Kaplan Meier Survival curves for

ARFAs and each of the three control groups (ARNFAs, NAFAs and NANFAs) were tested using the logrank test.

Hazard ratios for excess mortality (differences in mortality rates) for each of the four groups were calculated using Cox's proportional hazards regression, once proportional hazard assumptions had been tested using a log log plot. Statistically significant differences in survival curves were tested using Cox regression based test for equality of survival curves, χ^2.

7.4 Results

7.4.1 Prevalence and incidence of alcohol related liver disease amongst ARFAs

As shown in table 40 below, the greatest 5 year prevalence rates of alcohol related liver disease (ARLD) were seen amongst ARFAs and ARNFAs with 3422.2 and 1811.3 cases per 10,000 people compared to rates of 22.5 and 18.4 per 10,000 people for NAFAs and NANFAs respectively (χ^2 $p<0.001$). The prevalence rates of ARLD amongst ARFAs was almost double that for ARNFAs.

The prevalence rates of end stage ARLD amongst the 4 patient groups mirrored that seen for ARLD: the highest 5-year prevalence rate amongst ARFAs of 2098.0, followed by ARNFA 991.4, NAFA 12.7 and NANFA 10.9 cases per 10,000 people (χ^2 $p<0.001$), as shown in table 41 below. ARFAs had the greatest proportion of ARLD (62.7%) at end-stage than the other 3 groups.

Table 40: Prevalence of alcohol related liver disease amongst the four patient groups, 2011-2015/16

Alcohol-related liver disease	ARFA	ARNFA	NAFA	NANFA	Total
No	34,566	112,698	149,663	149,696	446,623
Yes	17,368	24,929	337	276	42,910
Total	51,934	137,627	150,000	149,972	489,533
Prevalence rate ARLD per 10,000 people	3422.2	1811.3	22.5	18.4	

χ^2 p<0.001

Table 41: Prevalence of end-stage alcohol related liver disease amongst the four patient groups, 2011-2015/16

Alcohol-related liver disease	ARFA	ARNFA	NAFA	NANFA	Total
No	41,038	123,982	149,810	149,808	464,638
Yes	10,896	13,645	190	164	24,895
Total	51,934	137,627	150,000	149,972	489,533
Prevalence rate end stage ARLD per 10,000 people	2098.0	991.4	12.7	10.9	
% end stage ARLD / all ARLD	62.7	54.7	56.4	59.4	

χ^2 p<0.001

Table 42 below shows that incidence of ARLD was greatest for ARFAs at 1945.1 cases per 10,000 patients, followed by ARNFAs 1078.0, NAFAs 14.9 and NANFAs 15.9 cases per 10,000 patients. The rate of new cases of ARLD amongst ARFAs was almost twice that seen for ARNFAs. Incidence of end-stage ARLD showed a similar picture across the 4 patient groups (see table 43): the highest incidence being seen in ARFAs, followed by ARNFAs with relatively low incidence in those with non-alcohol related hospital admissions. There was little difference in the number of new cases of end-stage ARLD seen as a proportion of all ARLD across the groups.

Table 42: Incidence of alcohol related liver disease amongst the four patient groups, 2012-2015/16

Alcohol-related liver disease	ARFA	ARNFA	NAFA	NANFA	Total
No	34,566	112,698	149,663	149,696	446,623
Yes	8,347	13,617	224	238	22,426
Total	42,913	126,315	149,887	149,934	469,049
Incidence rate ARLD per 10,000 patients	1945.1	1078.0	14.9	15.0	

χ^2 p<0.001

Table 43: Incidence of end-stage alcohol related liver disease amongst the four patient groups, 2012-2015/16

Alcohol-related liver disease	ARFA	ARNFA	NAFA	NANFA	Total
No	37,796	118,473	149,759	149,789	455,817
Yes	5,117	7,842	128	145	13,232
Total	42,913	126,315	149,887	149,934	469,049
Incidence rate ARLD per 10,000 patients	1192.4	620.8	8.6	9.7	
% end stage ARLD / all ARLD	61.3	57.6	57.1	60.9	

χ^2 p<0.001

7.4.2 Survival analysis and predictors of death for ARFAs

Comparison of 5 year death rates amongst the 4 groups (with no adjustment for age) shown in table 44 below reveal that ARFAs and NAFAs have the highest mortality rates at 1591.6 and 1356.9 per 10,000 people respectively, compared to ARNFAs (866.8 per 10,000) and NANFAs (524.0 per 10,000). Compared to death rates within the whole England population (including those outside hospital) which were 89.93 per 10,000 in 2016 for 1 year (equivalent to 0.90%), these rates are high but it should be remembers that death rates for the 4 groups are rates of death in hospital (i.e. in a largely sick population) as opposed to death rates within the whole of England and Wales which are measured in a largely well population.

Table 44: Deaths in hospital amongst the four patient groups, 2012-2015/16

	ARFA	ARNFA	NAFA	NANFA
Number of patients who died between 2012-2015/16	8,266	11,930	20,354	7,859
Total patients	51,934	137,627	150,000	149,972
% deaths within 5 years	15.9	8.7	13.5	5.2
5 year mortality rate per 10,000 patients	1591.6	866.8	1356.9	524.0

χ^2 p<0.001

Kaplan Meier survival curves for the 4 patient groups, without adjustment for age, (see figure 13 below) show ARFAs to have a lower probability (0.75) of being alive at 5 years (1825 days) than the other 3 patient groups. Within the first 300 days of admission, ARNFAs have a lower probability of survival than the other groups. The greatest likelihood of death for ARNFAs seems to occur in the first 30 days after first admission, shown by the steepest part of the curve.

Statistically significant differences between the Kaplan Meier Survival curves for ARFAs and each of the three control groups (ARNFAs, NAFAs and NANFAs) were tested using the logrank test, χ^2 p<0.001, which showed a significant difference between the number of observed and expected events for each of the four patient groups and provides strong evidence that the survival rates differ between the four groups.

Subsequently, age-adjusted 5-year survivor function, by patient type and age-group were calculated for each of the four patient groups, and are shown in table 45 below. Cox regression based test for equality of survival curves, χ^2 p<0.001 showed that survival curves for each of the four groups were significantly different. After age adjustments, ARFAs had the lowest survival in each age category amongst the four patient groups.

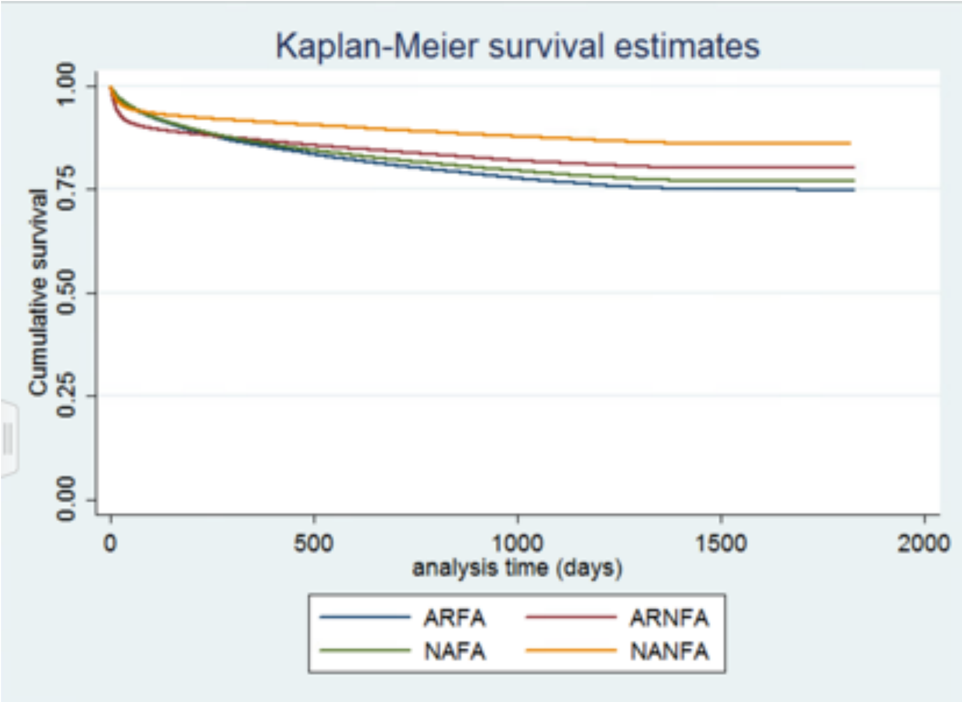

Figure 13: Survival curves for each of the four patient groups from the 2011/12 cohort

Table 45: Age-adjusted 5-year survivor function, by patient type and age-group

Age group (years)	ARFA	ARNFA	NAFA	NANFA	Cox regression based test χ^2
<=44	0.988	0.995	0.997	1.000	p<0.001
45-54	0.950	0.973	0.981	0.997	p<0.001
55-64	0.920	0.945	0.962	0.992	p<0.001
65-74	0.879	0.914	0.933	0.978	p<0.001
75+	0.284	0.377	0.365	0.517	p<0.001

Cox regression based test for equality of survival curves, χ^2 p<0.001

7.4.3 Excess mortality

Death rates for each of the 4 categories of patients (ARFA, ARNFA, NAFA and NANFA) were calculated, and adjusted for age (since previous studies described in chapter 4 showed that age breakdown differs across the four patient groups). Relative hazard of death (number of observed deaths/expected number of deaths) were calculated for 5 different age groups: under (and including) 44 years, 45-54 years, 55-64 years, 65-74 years and over 75 years using Cox regression, once the proportional hazards assumption had been tested using a log log plot (see figure 14 below).

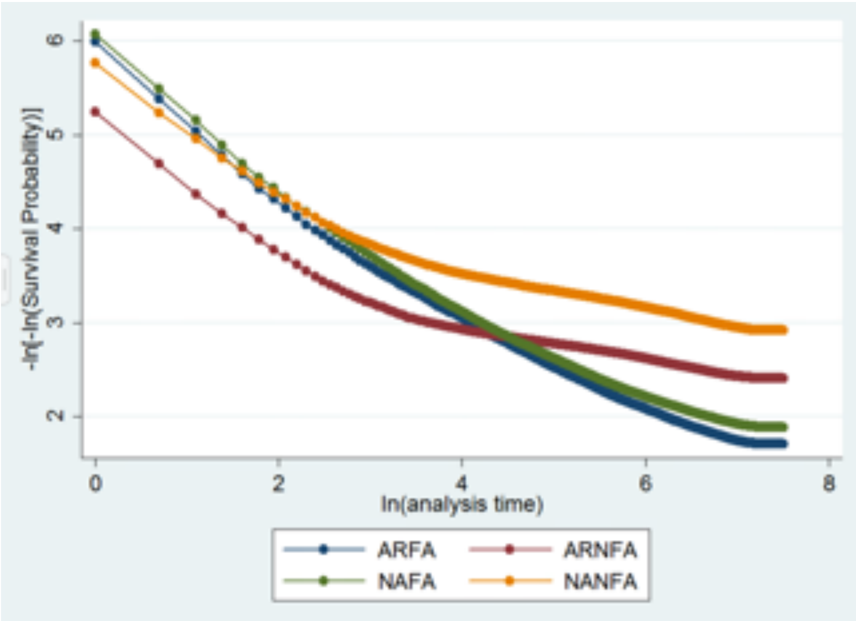

Figure 14: log log plot of probability of survival against time for the four patient groups

Log log plot of cumulative hazard against time for each of the four patient groups suggests some violation of the proportional hazards assumption since the lines for ARNFA and NANFA diverge from those for ARFA and NAFA. Assessment of assumption of proportional hazards was also made through tests of Schoenfeld residuals and modelling of the interaction of covariates with time in the analysis. Even with the addition of interaction terms for gender and time, and patient group and time, the proportional hazards assumptions were not met. Results of Cox regression for age adjusted deaths by age-group for the four patient groups are therefore shown in lifetable format in table 46 below.

Table 46: Age adjusted relative hazard (observed deaths over expected deaths) during 5 years by patient type and age-group

Age group	ARFA	ARNFA	NAFA	NANFA	Cox regression based test, χ^2
<=44	6.27	2.35	1.28	0.17	p<0.001
45-54	3.06	1.69	1.18	0.20	p<0.001
55-64	2.60	1.85	1.27	0.27	p<0.001
65-74	2.31	1.70	1.29	0.42	p<0.001
75+	1.39	1.15	1.12	0.77	p<0.001

The age-adjusted relative hazards in table 46 above show the ratio of observed deaths to expected deaths for each group of patients, split by five age categories: under 44 years, 45-54 years, 55-64 years, 65-74 years and over 75 years. The relative hazard is therefore a measure of excess mortality for each of the patient groups by age band. Results show that excess mortality is highest for ARFAs and ARNFAs in the under 44 year old age group compared to other age groups. In fact excess mortality seems to diminish in older age groups. ARFAs in the under 44 year old age group had the greatest excess mortality (hazard ratio 6.27) out of all patient groups for all age categories, followed by ARFAs in the 45-54 year age category. The results show that there is no excess mortality for NANFAs as fewer deaths than expected were observed. Excess mortality for NAFAs was highest in the 65-74 years category, but for all age groups was lower than that observed for ARFAs.

7.5 Summary

The greatest 5 year prevalence rates of alcohol related liver disease (ARLD) were seen amongst ARFAs and ARNFAs with 3344.2 and 1811.3 cases per 10,000 people compared to rates of 22.5 and 18.4 per 10,000 people for NAFAs and NANFAs respectively. The prevalence rates of end stage ARLD amongst the 4 patient groups reflected the pattern seen for ARLD: the highest 5 year prevalence rate being amongst ARFAs of 2098.0, followed by ARNFA 991.4, NAFA 12.7 and NANFA 10.9 cases per 10,000 people. ARFAs had the greatest proportion of ARLD (62.7%) at end-stage than the other 3 groups.

The rate of new cases of ARLD amongst ARFAs was almost twice that seen for ARNFAs. Incidence of end-stage ARLD showed a similar picture across the 4 patient groups: the highest incidence being seen in ARFAs, followed by ARNFAs with relatively low incidence in those with non-alcohol related hospital admissions. There was little difference in the number of new cases of end-stage ARLD seen as a proportion of all ARLD across the groups.

Kaplan Meier survival curves show ARFAs to have a lower probability of survival at 5 years than the other patient groups. After age adjustments, ARFAs had the lowest survival in each age category amongst the four patient groups.

Excess mortality across the 5 years measured by relative hazard for each of the groups, stratified by age category, was highest for ARFAs and ARNFAs in the under 44 year old age group compared to other age groups. ARFAs in the under 44 year old age group had the greatest excess mortality (hazard ratio 6.27) out of all patient groups for all age categories, followed by ARFAs in the 45-54 year age category. The fact that the proportional hazards assumptions were not met even with the addition of interaction terms, suggests that the differences between hazards are not constant against time for the two non-frequent attending groups which is interesting. This could be because for frequent attenders, additional risk of hazard is added to underlying risk of hazard from original admission with each subsequent admission, meaning the cumulative rate of hazard remains relatively constant, whereas for non-frequent attenders, risk of hazard is greatest soon after the isolated admission and then wanes with time.

Despite these analyses being restricted to only one specific, albeit highly serious medical condition (ARLD); and mortality occurring in hospital, it is striking that ARFAs have an exceptionally high risk both for the onset of ARLD and for death with the risk being particularly elevated among younger ARFAs relative to other patients of the same age. This highlights the importance of the research and need for intervention, which will be addressed further in chapter 9.

8 Prevalence of alcohol related frequent attenders in England, 2011-2016, and their patterns of health service use and cost to the health service

8.1 Background

The study presented in this chapter aims to identify the patterns of health service use of ARFAs prior to and subsequent to them becoming an alcohol frequent attender. In addition, a second aim is to understand the cost burden of ARFAs on the NHS.

A number of estimates of the cost of providing alcohol-related health care and wider societal costs have been previously made. In 2009 Rehm et al estimated the total costs of alcohol to be 2.5% of gross domestic product, equivalent to £49 billion in the UK during 2016 (Rehm et al, 2009). The Foundation for Liver Research predict that during the next 5 years the NHS will incur £17 billion in costs related to alcohol misuse (Foundation for Liver Research, 2017). Other estimates including costs to the NHS and loss of tax revenue putting costs up to £52 billion per year (Williams et al, 2018). In the UK it is estimated that direct costs to the NHS of alcohol are £3.5 billion annually, with 80% of those costs attributable to hospital based care (House of Commons, 2012). In 2016/17 total costs on admitted patient care were £26.9bn. In 2006 direct costs to the NHS alone were estimated at £374 million for alcoholic cirrhosis of the liver (Balakrishnan et al, 2009). A recent study (Phillips, 2017) calculated that the financial burden on emergency departments in England based on 2009/10 hospital episodes data was £38 million for wholly and partially alcohol attributable conditions during 2009/10. ARFAs of course are only responsible for part of the cost of alcohol to the health service and based on the definitions used in these studies, not all of their admissions will include a wholly or partially attributable diagnosis as shown in figure 15 below. To date no estimates have been made of the annual costs of ARFAs to the NHS so the study presented here is the first to calculate those costs.

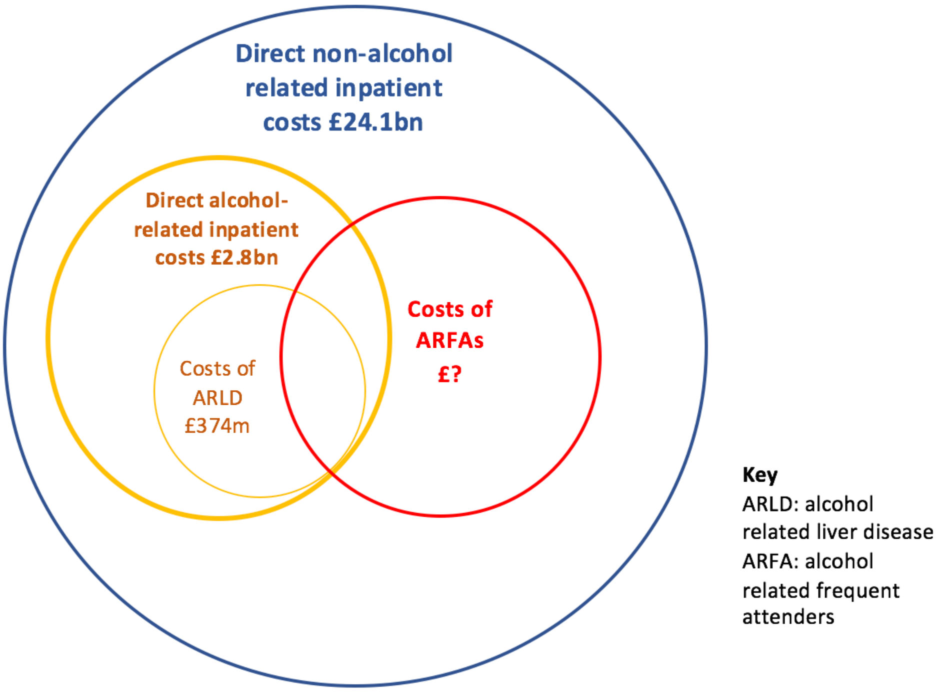

Figure 15: Proportion of total (£26.9bn) annual reference costs 2016/17 for NHS inpatient care

8.2 Analyses

A 5-year dataset including records of all adult persons admitted to hospital (Hospital Episode Statistics) in England between 1st April 2011 - 31st March 2016 was obtained from NHS Digital through the Data Access Request Service. Management, cleaning, storage and processing of the dataset is described in previous chapters (see chapter 3). The 5 year dataset was analysed in 3 ways, each of which is described in more detail later in this section:

1. Cross-sectional analysis of prevalence of alcohol and frequent admission status for each of the 5 years from 2011-2016.

2. Longitudinal 5 year analysis of health service use (2011-2016) prior to becoming an ARFA in 2015/16 (known as the 2015/16 cohort).
3. Longitudinal 5 year analysis of health service use after being identified as an ARFA in 2011/12 (known as the 2011/12 cohort).

8.2.1 Cross-sectional analyses of hospital admissions data, 2011-2016

Prevalence of patients in each of the four groups were calculated for each year and presented as rates per 10,000 hospital admissions for England.

8.2.2 Longitudinal analyses of alcohol related frequent attenders' hospital use, using routinely collected hospital data, 2011-2016

Longitudinal analyses of the 2011/12 and 2015/16 cohorts were undertaken. The entire 2011/12 and 2015/16 national admitted patient datasets were too large (approximately 7 million records per year in each dataset) to analyse in Stata so a sample of 2015/16 patients was selected then tracked through the data from 2015/16 back to 2011/12. Similarly a sample of 2011/12 patients was selected and followed forward through the data to 2015/16. Total sample size was based on the largest overall cohort size that could be analysed in practice within Stata v12 MP, with a 1:3 ratio of index group (ARFAs) to each of the controls (ARNFAs, NANFAs, NAFAs) where possible. Details of sampling are given in sections 3.10.2 and 3.11.3 of methods, chapter 3.

8.2.2.1 Pattern of health service use prior to becoming an ARFA: a 5-year retrospective study of ARFAs identified in 2015/16

This analysis included patients selected from the 2015/16 data, as described above. Hospital admission records between 2011/12 -2015/16 for all ARFAs identified in England on the basis of their alcohol diagnosis and frequent attending status during 2015, were analysed according to whether they were an ARFA for the first time in 2015/16 or not, had had a previous alcohol admission in 2011/12-2014/15 or been a frequent attender in 2011/12-2014/15. ARFAs were compared to the three control groups (ARNFAs, NANFAs, NAFAs) on:

- average number of admissions,
- lengths of stay, and
- occupied bed-days prior to becoming an ARFA.

8.2.2.2 Pattern of health service use for ARFA over 5 years: a study of ARFAs identified in 2011/12

This analysis included patients selected from the 2011/12 data, as described above, referred to as the 2011/12 cohort. Hospital admission records between 2011/12 -2015/16 for all ARFAs identified in England on the basis of their alcohol and frequent attending status during 2011/12 were analysed. Hospital admissions, in terms of average number of admissions, lengths of stay and occupied bed-days subsequent to becoming an ARFA were determined. Findings for ARFAs were compared to the 3 control groups (ARNFAs, NANFAs, NAFAs).

8.2.3 Sample

Cross sectional analysis

For the cross-sectional analysis the entire 5-year hospital admissions dataset for England, excluding poorly labelled or miscoded entries were included in the analysis. Included in the dataset were: all adult patients aged 18 years or over who have been treated in English hospitals between 01/04/2011 and 31/03/2016, whose hospital episode data was captured, was complete and valid on NHS Digital's Hospital Episodes Statistics database.

Selecting the 2015/16 cohort for longitudinal analysis

All 54,369 alcohol related frequent attenders identified from the national 2015/16 admissions data were included in the 2015/16 cohort. 136,015 alcohol related non-frequent attenders were included in the 2015/16 cohort and this was the entire national ARNFA group. Although the number of patients in the ARNFA group fell slightly short of the intended 3 x index group size, this was the entire national sample. Using Microsoft SQL Server Management Studio, a random sample of 150,000 patients from each of the non-alcohol non-frequent attending group and the non-alcohol frequent attending groups in 2015/16 were selected. Randomisation was achieved by allocating each individual patient within those groups a new row identification number (*NEWID* function) and then selecting 150,000 rows at random from each of the 2 groups.The make-up of the final 2015/16 cohort is summarised in table 47 below. The final 2015/16 cohort consisted of 490,384 patients with 4,605,260 consultant episodes.

Table 47: Summary of the 2015/16 cohort and sampling

	No. of patients included in the sample	% of all patients in the 2015/16 national dataset included in the sample
ARFAs	54,369	100
ARNFAs	136,015	100
NAFAs	150,000	12.6
NANFAs	150,000	0.024
Total	490,384	6.41

Selecting the 2011/12 cohort for longitudinal analysis

All 51,934 alcohol related frequent attenders identified from the national 2011/12 admissions data were included in the 2011/12 cohort. 137,646 alcohol related non-frequent attenders were included in the 2011/12 cohort and this was the entire national ARNFA group. Although the number of patients in the ARNFA group fell slightly short of the intended 3 x index group size, this was the entire national sample. Using Microsoft SQL Server Management Studio, a random sample of 150,000 patients from each of the non-alcohol non-frequent attending group and the non-alcohol frequent attending groups in 2011/12 were selected (as described in the previous section of this chapter). Randomisation was achieved by allocating each individual patient within those groups a new row identification number (*NEWID* function) and then selecting 150,000 rows at random from each of the 2 groups.The make-up of the final 2011/12 cohort is summarized in table 48 below. The final 2011/12 cohort consisted of 489,580 patients with 4,740,217 consultant episodes.

Table 48: Summary of the 2011/12 cohort and sampling

	No. of patients included in the sample	% of all patients in the 2011/12 national dataset included in the sample
ARFAs	51,934	100
ARNFAs	137,646	100
NAFAs	150,000	13.9
NANFAs	150,000	0.025
Total	489,580	6.81

8.2.4 Calculating the cost of ARFAs over a 5 year period

Costs of the 2011 cohort over the subsequent 5 year period were estimated for each of the 4 patient groups using NHS reference costs for the relevant year (see methods section 3.12.14 for full details). Having calculated the total costs including excess beddays for each of the four patient groups in the 2011 cohort across the 5 years, a mean cost per person (in each of the four patient groups in the initial cohort) was derived.

8.3 Results

8.3.1 Prevalence of ARFAs in England, 2011/12-2015/16

In 2015/16, out of a total 7,654,944 patients admitted to hospital, 54,369 alcohol related frequent attenders were identified; as well as 146,015 alcohol related non-frequent attending patients, 1,187,312 non-alcohol related frequent attenders; and 6,277,248 non-alcohol non-frequent attenders. The total number of patients in each group for each of the five years of HES records is shown in table 49 below. The prevalence of patients within each group by year per 10,000 admissions (shown in table 50 below) and adjusted (table 51 below) by total England population.

Table 49: Total patients admitted to hospital in England, 2011-2015, by alcohol and frequent attending status

	2011/12	2012/13	2013/14	2014/15	2015/16
ARFAs	51,934	50,397	52,344	52,450	54,369
ARNFAs	137,646	134,331	137,672	133,950	136,015
NAFAs	1,078,057	1,088,068	1,117,771	1,158,458	1,187,312
NANFAs	5,920,231	5,948,081	6,037,747	6,175,522	6,277,248
Total	7,187,868	7,220,877	7,345,534	7,520,380	7,654,944

Table 50: Rate amongst all hospital admissions in England of alcohol-related admissions and frequent attending, 2011/12-2015/16, per 10,000 admissions

	2011/12	2012/13	2013/14	2014/15	2015/16
ARFAs	72.252	69.793	71.260	69.744	71.025
ARNFAs	191.498	186.031	187.423	178.116	177.683
NAFAs	1499.829	1506.836	1521.701	1540.425	1551.039
NANFAs	8236.421	8237.339	8219.616	8211.715	8200.253

Table 51: Prevalence of alcohol-related admissions and frequent attending, 2011/12-2015/16, per 100,000 England population (ONS, mid-year estimates)

	2011/12	2012/13	2013/14	2014/15	2015/16	% change between 2011-15
ARFAs	97.79	94.21	97.17	96.56	99.24	1.48
ARNFAs	259.19	251.12	255.58	246.61	248.26	-4.21
NAFAs	2029.96	2034.01	2075.10	2132.79	2167.17	6.76
NANFAs	11147.70	11119.21	11208.87	11369.49	11457.69	2.78
All	13534.64	13498.55	13636.73	13845.45	13972.36	3.23

Between 2011- 2015, between 50,000 and 55,000 ARFAs were admitted to hospital each year in England. This is equivalent to a prevalence rate of approximately 70 per 10,000 (0.7%) people admitted to hospital in England, for each of the 5 years of data; and equivalent to 97 per 100,000 people in England each year. Rates of alcohol-related frequent attending appear to have remained fairly static across the 5 years 2011-2015. As shown in table 51 above, overall hospital admission rates in England have risen between 2011/12-2015/16 by 3.2%, with the greatest rise in admissions being seen amongst non-alcohol related frequent attenders. Rates of ARFA admissions rose by 1.48% across the 5 year period. In 2011/12, ARFAs made up 27% of all alcohol attenders and 5% of all frequent attenders.

8.3.2 Pattern of health service use prior to becoming an ARFA: a 5-year retrospective study of ARFAs identified in 2015/16

Alcohol and frequent attending status prior to 2015/16

During at least 1 of the years between 2011/12 and 2014/15, 19,762 of the 54,369 ARFAs identified in 2015/16 had been ARFAs before, that is to say, 36.2% of ARFAs in 2015/16 had previous history of being an ARFA.

Amongst the 2015/16 ARFA cohort, 41,590 patients (76.2%) had not been ARFAs in the preceding year, 2014/15. In addition, 34,789 patients from the 2015 ARFA cohort had never been an ARFA in any year between 2011/12 and 2014/15 prior to becoming an ARFA in 2015/16 i.e. 63.8% of patients from the 2015 ARFA cohort were ARFAs for the first time in 2015/16.

In total 30,990 patients (56.8%) from the 2015 ARFA cohort had had at least 1 alcohol admission in 1 of the years between 2011/12-2014/15.

Further analyses in table 52 below show the average length of stay for the four patient groups in the cohort for 2015/16, for years 2011/12-2015/16. There is a statistically significant difference between all of the mean lengths of stay between ARFAs and control groups across all years using the Bonferroni multiple comparison test $F(3, 488570) = 1088.37$ $p<0.001$. ARFAs identified in 2015/16 had an average length of stay of 5.55 days in 2015/16, which was longer than all other patient groups in the same year.

Table 52: Average length of hospital stay (days) for the 2015/16 ARFA cohort, from 2015/16 - 2011/12, compared to control groups in years preceding index year

	2015/16	2014/15	2013/14	2012/13	2011/12
ARFA	5.55	4.84	4.58	4.62	4.47*
ARNFA	4.70	5.81	5.80	5.67	5.00*
NAFA	3.39	2.96*	2.87**	2.80b	2.72a
NANFA	2.57	3.14*	3.31**	3.20b	2.85a
Bonferroni multiple comparison test for difference in means	F= 1088.37 (3, 488570) p<0.001	F =285.89 P<0.001 (3,213923)	F =85.45 P<0.001 (3,179715)	F = 41.34 P<0.001 (3, 160679)	F = 114.36 P<0.001 (3, 148154)

Values within year are significantly different p<0.001 unless stated otherwise: *p<0.05; **p<0.02;
Same subscripts (a, b) indicate where values are not significantly different from each other

Following the entire 2015/16 cohort back through previous years (table 52) showed that ARFAs identified in 2015/16 had statistically significantly longer average lengths of hospital stay (ALOS) than the three other patient groups in 2015. However, prior to 2015, ARNFAs (non-frequent alcohol related admissions) had the longest length of stay. Alcohol related frequent attenders had significantly longer lengths of stay than non-alcohol related frequent attenders.

New ARFAs within the 2015/16 ARFA cohort

34,789 patients from the 2015 ARFA cohort who had never been an ARFA in any year between 2011/12 and 2014/15 (prior to becoming an ARFA in 2015/16) were classified as new ARFAs. The mean number of admissions per year (table 53) and ALOS for new ARFAs were compared to all other ARFAs. New ARFAs in 2015 had an ALOS of 4.46 days compared to 4.58 days for people who had been ARFAs prior to 2015. This was not a statistically significant difference in mean length of stay.

Table 53: Trends in mean number of spells per year for the 2015/16 ARFA cohort, compared to control groups, 2011/12-2015/16

	2015	2014	2013	2012	2011
ARFA	5.38	5.97	5.79	5.55	5.64
ARNFA	1.31	1.42a	1.40b	1.39c	1.39d
NAFA	5.98	8.27	8.00	7.68	7.33
NANFA	1.24	1.31a	1.29b	1.29c	1.28d
Bonferroni multiple comparison test for difference in means	F=20536.25 (3, 490380) p<0.001	F=8854.23 (3, 214905) p<0.001	F=7070.63 (3, 180366) p<0.001	F=6248.30 (3, 161202) p<0.001	F=5688.97 (3, 148567) p<0.001

Same subscripts (a-d) indicate where values are not significantly different from each other
Values within year are significantly different p<0.001 unless stated otherwise

Occupied beddays for the 2015/16 cohort

Total and mean occupied bed-days for the 2015/16 cohort in the index and preceeding years are shown in table 54 below. The ARFA group in the index year had the highest mean occupied beddays per person compared to other patient groups that years, and mean OBDs per person for ARFAs were consistently higher in all years prior to the index year as a fraction of the original 2015/16 cohort and per person attending in each year.

Table 54: Mean occupied bed-days (OBDs) per person remaining from the original 2015/16 cohort per year, and per person attending each year, for each category of patients, from 2015/16- 2011/12

		2015	2014	2013	2012	2011	Total OBDs across all years
ARFAs							2,967,526
	People	54,369	35,083	29,157	25,664	23,462	
	OBDs	1,402,600	558,690	405,115	324,527	276,594	
	Mean OBDs/person remaining/year	25.80	10.28	7.45	5.97	5.09	
	Mean OBDs/person attending/year	25.80	15.92	13.89	12.65	11.79	
ARNFAs							2,360,670
	People	136,015	47,415	42,080	37,773	35,473	
	OBDs	962,718	440,281	367,600	310,374	279,697	
	Mean OBDs/person remaining/year	7.08	3.24	2.70	2.28	2.06	
	Mean OBDs/person attending/year	7.08	9.29	8.74	8.22	7.88	
NAFAs							4,245,975
	People	150,000	85,307	68,249	59,874	54,570	
	OBDs	2,225,528	746,807	519,425	410,467	343,748	
	Mean OBDs/person remaining/year	14.84	4.98	3.46	2.74	2.29	
	Mean OBDs/person attending/year	14.84	8.75	7.61	6.86	6.30	
NANFAs							1,263,796
	People	150,000	47,104	40,884	37,895	35,066	
	OBDs	497,028	252,341	200,834	168,978	144,615	
	Mean OBDs/person remaining/year	3.31	1.68	1.34	1.13	0.96	
	Mean OBDs/person attending/year	3.31	5.36	4.91	4.46	4.12	

8.3.3 Pattern of health service use after becoming an ARFA: a 5-year prospective study of ARFAs identified in 2011/12

Results in table 55 below show the average length of stay for the four patient groups in the cohort for 2011/12, for years 2011/12-2015/16. The 2011 ARFA cohort had statisctically significant and consistently longer average lengths of stay than the 3 other patients groups for all years subsequent to the index year.

In 2011 although ARNFAs had a slightly longer average length of stay than ARFAs, this was not a statistically significant difference. Between 2011 and 2016 average length of stay for ARFAs increased from 4.90 days to 6.42 days. Average length of stay for ARNFAs reduced from 5.01 days to 3.41 days over the corresponding time period. Average lengths of stay for NAFAs and NANFAs remained relatively static between 2011-2016.

Table 55: Trends in average length of hospital spell (days) for the 2011/12 cohort, from 2015/16-2011/12, compared to control groups

	2011	2012	2013	2014	2015
ARFA	4.90^{a}	4.76	6.02	5.88	6.42
ARNFA	5.01^{a}	4.47	4.66^{b}*	3.56^{cd}	3.41^{ef}
NAFA	3.13	3.34*	3.83^{b}**	3.67^{c}*	$3.88^{e,}$†
NANFA	2.47	2.98*	3.05*,**	2.55^{d}*	2.68f,†
Bonferroni multiple comparison test for difference in means	F= 2250.41 (3, 487785) p<0.001	F =377.64 P<0.001 (3,208435)	F =158.34 P<0.001 (3,177654)	F = 126.11 P<0.001 (3, 160351)	F = 79.69 P<0.001 (3, 147108)

Values within year are significantly different p<0.001 unless stated otherwise: *p<0.005; **p<0.02; †p<0.05
Same subscripts (a-f) indicate where values are not significantly different from each other

Analysis of the mean number of spells per year for the patient groups shown in table 56 below shows ARFAs and NAFAs from the 2011 cohort to have the greatest number of spells per year (a similar picture to that seen for the 2015 cohort). All four patient groups had significant increases in the number of spells per year over the 5 year period.

Table 56: Mean number of spells per year for ARFAs, compared to control groups, 2011/12-2015/16

	2011	2012	2013	2014	2015	Test for difference in means
ARFA	6.72	7.63[a]	7.62[a]	7.51[a,b]	7.32[b]	F=24.16 (4,113879)
ARNFA	2.23	3.29	3.44[cd]	3.47[c]*	3.36[d]*	F=885.03 (4,219610)
NAFA	6.69	7.97[e]	7.86[e]**	7.60**	7.31	F=54.28 (4,292644)
NANFA	1.89	2.66†,**[,g]	2.75†[,f,h]	2.77**[,f,i]	2.69[g,h,i]	F=356.31 (4,225646)

Same subscripts (a-i) indicate where values are not significantly different from each other
Values within year are significantly different p<0.001 unless stated otherwise:*p<0.005;**p<0.02;†p<0.05;

As shown in table 57 below, the mean OBDs per year for each of the four patient groups reveals that like the 2015 cohort, the 2011 ARFA cohort had the highest mean OBD per year of all four patient groups every year.

Table 57: Mean occupied beddays per person per year from the original cohort, and per person attending each year, for each category of patients first identified in 2011, from 2011/12-2015/16

		2011	2012	2013	2014	2015	Total OBDs across all years
ARFAs							
	People	51,934	33,256	27,080	23,247	20,548	3,053,774
	OBDs	1,249,020	562,356	482,638	400,399	359,361	
	Mean OBDs/person remaining/year	24.05	10.83	9.29	7.71	6.92	
	Mean OBDs/person attending/year	24.05	16.91	17.82	17.22	17.49	
ARNFAs							
	People	137,646	47,176	42,906	39,402	37,085	2,591,243
	OBDs	838,358	445,018	472,787	426,388	408,692	
	Mean OBDs/person remaining/year	6.09	3.23	3.43	3.10	2.97	
	Mean OBDs/person attending/year	6.09	9.43	11.02	10.82	11.02	
NAFAs							
	People	150,000	82,008	65,496	57,626	51,301	4,766,892
	OBDs	2,206,405	841,003	673,622	555,806	490,056	
	Mean OBDs/person remaining/year	14.71	5.61	4.49	3.71	3.27	
	Mean OBDs/person attending/year	14.71	10.26	10.28	9.65	9.55	
NANFAs							
	People	150,000	46,575	42,786	40,693	38,667	1,556,443
	OBDs	479,807	273,835	283,390	264,794	254,617	
	Mean OBDs/person remaining/year	3.20	1.83	1.89	1.77	1.70	
	Mean OBDs/person attending/year	3.20	5.88	6.62	6.51	6.58	

Interestingly, table 57 shows that for the alcohol non-frequent attenders and the non-alcohol non-frequent attenders, the number of occupied bed-days per person attending hospital each year, increases. This corresponds with a decreasing number of patients attending hospital each year from the original cohort. This suggests that people are either having more frequent stays in hospital each year (and could potentially be moving towards becoming a frequent attender); or their spells are longer each year, which could reflect the fact that more of the patients still remaining from the original cohort as time goes on are more likely to be those who have chronic diseases, requiring increasingly longer stays in hospital.

A plot of the change in OBDs prior to becoming an ARFA for the 2015 cohort and decay in OBDs subsequently for the 2011 ARFA cohort is shown in figure 16 below. The plot shows a sharp increase in activity in the year preceding becoming an ARFA and ensuing sharp reduction in ARFA activity following the index year.

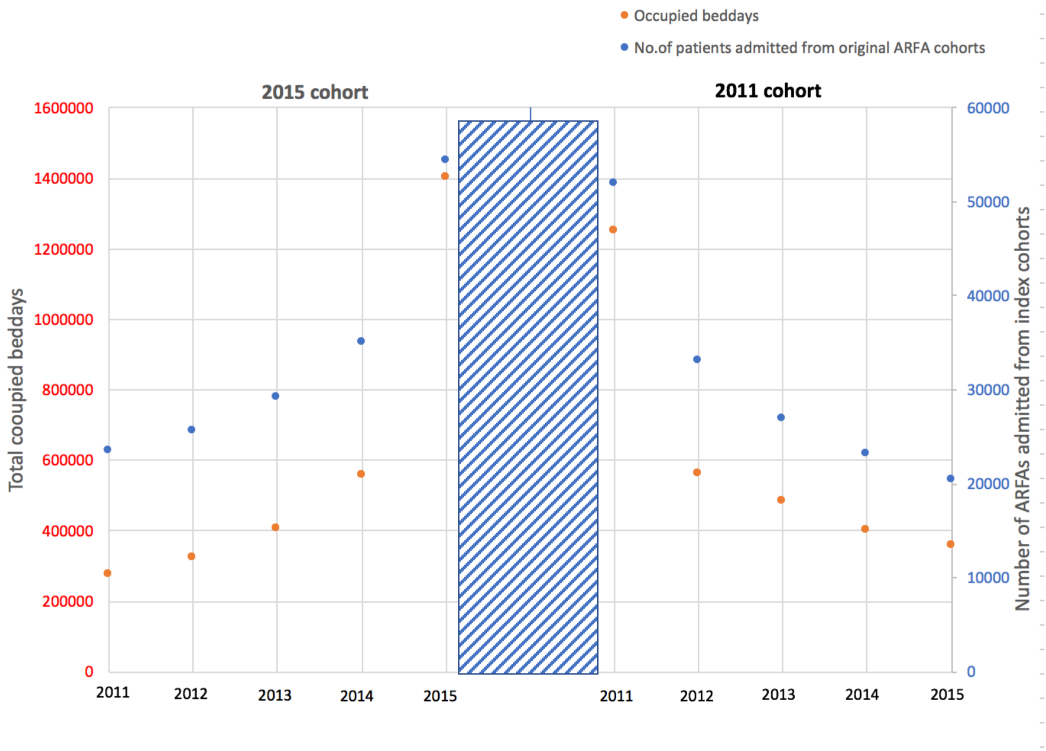

Figure 16: Plot of number of ARFAs from 2011 and 2015 index cohorts admitted each year and total ARFA occupied beddays each year

8.3.4 Calculating the cost of ARFAs over a 5 year period

Table 58 shows the estimated average number of spells by type and cost per patient for each patient group from the 2011 cohort for the 5 year period of time. ARFAs had the highest average cost per person over 5 years at £38,189; followed by NAFA at £32,714; ARNFAs £9,837 and NANFAs £6,743. Extrapolating these figures to include all patients admitted in England in 2011, results in an average cost for 1 year for all ARFAs equal to £396m on inpatient admissions, which was higher than the costs for all other alcohol (ARNFA) admissions at £270m, but lower than the total costs for NAFAs and NANFAs. The actual cost of each of the four patient groups during 2011/12 only is shown in table 59 below.

Table 58: Estimated average number of spells by type and average cost per person over 5 years, by alcohol and frequent admission status, for the 2011 patient cohort

	ARFA	ARNFA	NAFA	NANFA
Day case spells	40,959	51,795	509,345	158,919
Elective inpatient spells	137,365	72,798	755,181	98,906
Non-elective inpatient longstay spells	375,773	247,182	455,403	126,721
Non-elective inpatient shortstay spells	202,797	195,921	312,965	111,224
Total people	51,934	137,646	150,000	150,000
Average cost over 5 years per person	£38,189	£9,837	£32,714	£6,743
Estimated actual cost for all 2011/12 England inpatient admissions during 2011/12	£764,288,591	£392,345,044	£14,462,468,679	£11,336,025,882

8.4 Summary

8.4.1 Prevalence of ARFAs in England

Between 2011- 2015, between 52,000 and 54,000 ARFAs were admitted to hospital each year in England. This is equivalent to a prevalence rate of approximately 70 per 10,000 (0.7%) people admitted to hospital in England, for each of the 5 years of data; and equivalent to 97 per 100,000 people in England each year. The European Union (European Commission, 2008) defines rare diseases as those affecting fewer than 5 per 10,000 people. While ARFA is not a disease in its own right, these figures suggests that it is certainly not a rare condition. Rates of alcohol-related frequent attending remained fairly static across the 5 years 2011-2015.

8.4.2 Patterns of service use before becoming an ARFA: results from the 2015/16 cohort

Prevalence

Results from the retrospective 2015/16 study demonstrated that the majority (63.8%) of ARFAs in 2015 were new ARFAs (with no previous record of being an alcohol-related frequent attender between 2011-2014). The obverse is that more than a third of ARFAs (36.2%) have a chronic history of alcohol related frequent attending. Even amongst new ARFAs, more than half had had a previous admission for a wholly attributable alcohol diagnosis in the previous 4 years.

Average length of stay

In the index year (2015/16) ARFAs had the longest average length of stay compared to the control groups. In years preceding the index year, patients who were identified as ARNFAs in 2015/16 had statistically significantly longer average lengths of stay than the other groups, closely followed by ARFAs. Prior to the index year, average length of stay within groups remained relatively stable across the years between 2011-2014, but in 2015/16, a shift in average length of stay occurred within the ARFA and ARNFA groups resulting in an increase for ARFAs and decrease for ARNFAs in average lengths of stay compared to previous years. This could suggest a change in membership of the groups and potentially a transition occurring from ARNFA status to ARFA. Comparison of average lengths of stay for ARFAs and new ARFAs showed no significant difference in length of stay, so the shift in average length of stay seen for ARFAs and ARNFAs in the year prior to the index year is unlikely to be due to new ARFAs joining the cohort.

Average number of spells

Comparison of average number of spells for the 2015/16 cohort in the years prior to the index year, showed that patients identified as NAFAs and ARFAs in 2015/16 had statistically siginificant greater number of mean spells per year than non-frequent attending groups, with NAFAs having more spells on average per year than ARFAs. The mean number of spells per year for the 2015/16 cohort remained relatively static in years 2011-14. This again reinforces the chronic nature of ARFAs and demonstrates an extended length of time over which ARFA admissions are impacting on NHS services.

Occupied beddays

Calculation of total and mean occupied beddays (OBDs) allows the combined effects of average length of stay, mean spells and total patients to be compared across groups in the years prior to the index year. When average length of stay and mean spells are looked at in isolation, small differences between ARFAs and NAFAs are observed. However, their combined effects as seen in OBDs, demonstrate a more stark difference, with an average ARFA accounting for more than 10 additionals beddays per year per person compared to an average NAFA. This reinforces the point that the longer average length of stay for an ARFA has a significant impact on the burden borne by the NHS of frequent attending patients, even though NAFAs are admitted more frequently on average than ARFAs.

8.4.3 Patterns of service use after becoming an ARFA: results from the 2011/12 cohort

Average length of stay

The increase in average length of stay seen for the 2011 cohort over subsequent years could represent the development of an increasingly chronic and complex picture for ARFAs, requiring longer lengths of inpatient care, The reduction in average lenth of stay for ARNFAs during the the corresponding time period suggests a different clinical picture for ARFAs compared to ARNFAs.

Mean number of spells

Looking at the mean number of spells over the 5 year time period for 2011 ARFA and ARNFA cohorts, shows that from 2012 onwards, the ARNFA cohort mean number of spells increased each year to above the threshold for becoming an ARFA. This perhaps supports the explanation of a shift in characteristics of the ARFA group over time, showing a transition between ARNFA to ARFA. As demonstrated by the 2015 cohort, the 2011 ARFA and NAFA cohorts have the greatest mean number of spells in hospital each year.

Occupied beddays

Analysis of mean OBDs for the 2011 cohort illustrates a gradual reduction for the ARFA cohort across the years unlike that seens for the ARNFA and NANFA groups. NAFA also see a reduction in OBDs across the 5 years. Within 3 years of the index year the 2011 ARFA cohort had more than halved in number while their average spells had modestly increased. Again, as reflected in the 2015 cohort, it seems to be the increase in average length of stay for ARFAs that has the biggest influence on mean OBDs per person. This increase in average length of stay is likely to reflect contributions from one or all of the following factors: increasing complexity of patient, increasing severity of chronic illness, increasing complexity of social situation resulting in delayed discharge.

Reasons for the sudden drop in ARFA activity following the index year, as illustrated in the plot (figure 16) could be due to deaths within the cohort, or improvement in health status within the cohort (reducing the need for hospital admission), however the increase in mean OBDs per person shown in table 57 suggest that the remaining members of the cohort are spending more time in hospital each year and therefore deaths may therefore be the more likely explanation for reduced activity amongstthe ARFA cohort.

8.4.4 Estimated costs

ARFAs had the highest average cost per person over 5 years at £38,189, followed by NAFA at £32,714, ARNFAs £9,837 and NANFAs £6,743. Taking into account the size of each of the four patient groups on a national basis, extrapolating these figures to include all patients admitted in England in 2011, shows that the cost for 1 year for all ARFAs was £764m on inpatient admissions, which was higher than the costs for all other alcohol (ARNFA) admissions at £392m, but lower than the total costs for NAFAs (£14bn) and NANFAs (£11bn). These figures can now be added to figure 15 from earlier in this chapter and the fully populated diagram is shown in figure 17 below.

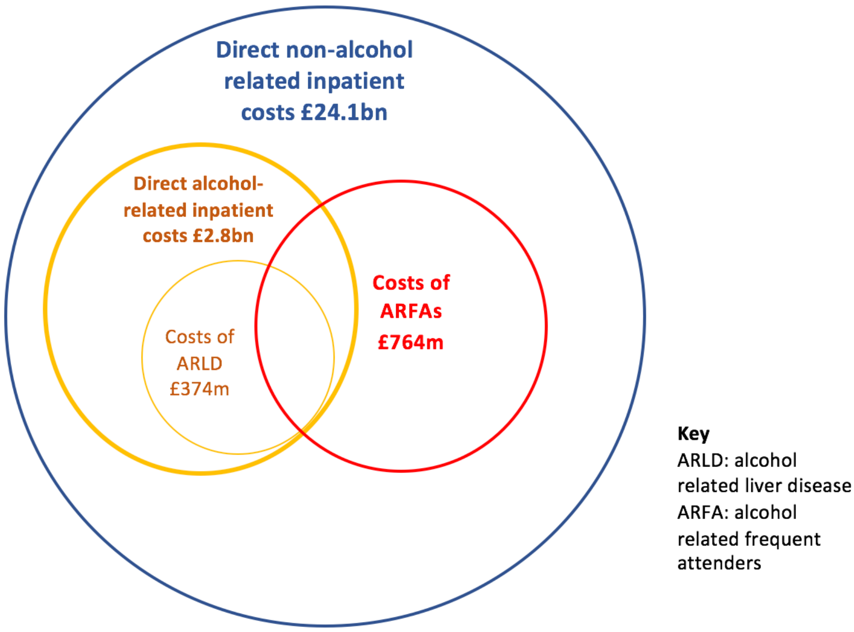

Figure 17: ARFA costs as a proportion of total costs of NHS inpatient care costs

The costs for ARFAs and ARNFAs only take in to account the costs associated with admissions for people who had a wholly attributable alcohol diagnosis. Costs presented only take in to account the cost of the inpatient stay and do not take in to account mental health inpatient, community health, ambulance, outpatient or emergency department costs.

9 Discussion

9.1 Introduction

Alcohol is a major global public health problem, resulting in disability and premature mortality as well as impacting on health, social care, welfare and criminal justice systems (WHO, 2014; Rehm et al, 2009b; Shield et al, 2012; Lim et al, 2012). The impact of alcohol on health services has been reasonably well documented from the perspective of the emergency room (Skinner, Carton and Haxton, 2009; Hughes et al, 2013; Smyth, 2011; McCormack et al, 2013; McCormack, Goldfrank and Rotrosen, 2014; Phillips, Coulton and Drummond, 2016), but less is known about the impact of alcohol on inpatient services. In particular, recent studies (Neale et al, 2017; Passetti et al, 2008; Drummond et al, 2017) suggest that there is a group of patients who are frequently admitted to hospital because of alcohol, due to the chronic relapsing nature of alcohol dependence, high levels of chronic and physical mental health, injuries caused by alcohol and general life-style related health problems (tooth decay and malnutrition).

This thesis documents the prevalence and incidence of ARFAs within England, investigates the complexity of ARFAs' health problems, their long-term health outcomes including mortality and estimates the costs of ARFA admissions. Until I undertook the studies presented in this thesis, relatively little has been known about the numbers of alcohol-related frequent attenders (ARFAs) within England, or indeed the health status of these individuals, cause of their multiple admissions, longer term health outcomes or the cost to health services. Estimates have been made of the burden of alcohol related frequent attenders to the NHS in the short-term (Phillips, 2017) but not over longer periods of time. Whilst reporting of alcohol admissions is now in the public domain with Public Health England publishing hospital admission statistics by geographical area for alcohol-specific and alcohol-related admissions, repeat or frequent admissions for alcohol are not routinely monitored or reported. The presentation of data on repeat admissions for alcohol over a 5-year period within this thesis is therefore novel and provides important information about patterns of health care utilisation among this group.

By applying a classification to admitted patients within the national dataset of inpatient hospital admissions in England, I was able to identify patients frequently admitted to hospital due to alcohol, to provide the first large-scale investigation of their sociodemographic characteristics, patterns and predictors of service use, along with outcomes and scale of burden for this group of patients. This research investigated a group of patients who are frequently admitted to hospital for alcohol-attributable conditions. This patient group are thought to be a high-cost high-need group, yet little was known about their socio-demographic characteristics, their longer-term health outcomes and their patterns of health service use. My research addressed a number of key knowledge gaps in the literature and provided key insights into the following issues:

- Identifying in a sample of hospital attenders, which medical and socio-demographic characteristics are associated with alcohol-related frequent admission and different patterns of health service utilisation.
- Identifying in a sample of alcohol-related frequent attenders, whether future health service usage can be determined by service-user characteristics.
- Investigating longer-term health outcomes for ARFAs including prevalence of alcohol-related liver disease, mental health disorders and mortality.
- Estimating the costs to the UK health service of inpatient stays for alcohol-related frequent attenders.

The research addressed the following research questions:

- Do ARFAs account for a disproportionately larger share of inpatient bed days than other patient groups?
- Do ARFAs have more medical and psychiatric co-morbidities (i.e. are more complex) than other types of frequently admitted patients?
- Is there is a higher incidence of ARFAs in the most deprived geographical areas compared to the least deprived?
- Can multiple medical and socio-demographic characteristics predict transition to alcohol related frequent attendance?
- Do ARFAs have poorer health outcomes compared to other frequent attenders including shorter survival?
- Does the cost of health service usage by ARFAs represents a disproportionately large burden to the NHS compared to other service users?

This chapter will first summarise the findings of each of the studies conducted in the thesis, interpret the findings of each of the studies, review the strengths and limitations of the research presented, and finally comment on directions for future research and implications for practice.

9.2 Summary of findings

9.2.1 Charactertistics of alcohol related frequent attenders

I conducted a systematic review to identify and summarise all existing published research describing individuals who are frequently admitted to hospital due to alcohol in terms of their demographics, their medical presentations and their personal circumstances. A key finding of this review was that, despite acknowledged ongoing concerns about this patient group, there has been remarkably little empirical research on them. In particular, much of the existing literature has been based on relatively small samples, with limited comparison groups.

Nonetheless, it is clear from this literature that ARFAs have high levels of multi-morbidity, including both physical and mental illness; experience social isolation; poor quality of life; unstable housing or homelessness; high criminal justice involvement; unemployment and low socioeconomic status (Kent and Yellowlees, 1994; McCormack et al, 2013; Hughes et al, 2013; Schomerus et al, 2011; Skinner, Carter and Haxton, 2009; Mannix et al, 2014). ARFAs tend to be older than alcohol-related non-frequent attenders (Holland, 1984; Lekharaju, 2014) and racially diverse (McCormack, Goldfrank and Rotrosen, 2014). Notably, they have either poor or no engagement with existing specialist alcohol treatment services (Ponzer, Johansson and Bergman, 2002). Qualitative research has also identified that ARFAs experience high levels of stigma and social exclusion (Siegel, Alexander and Lin, 1984; Neale et al, 2017). The impact of these characteristics on the health outcomes of ARFAs are unclear.

At the time of the literature review, it was remarkable that only one published study had examined ARFAs using Health Episode Statistics (HES), but this did not include the investigation of risk factors for readmission or predictors of becoming an ARFA (Lekharaju et al, 2014). Additional studies have analysed HES to examine risk factors for frequent emergency admission, but ARFAs were not examined as a specific subset within that work. More recently HES data has been used to estimate the burden of alcohol related attenders but mainly focused on the impact on emergency departments (Phillips, 2017; Currie et al, 2015). Results of the studies presented in this thesis therefore fill an important gap in knowledge about ARFA: and the longitudinal analysis of HES to better understand the natural history of ARFAs is novel and addresses an important gap in the literature.

Study 1 described the socio-demographic characteristics of ARFA patients, and tested the hypotheses that ARFAs are mostly older males, and live in the most deprived geographical areas, using univariable and multivariable analyses.

Approximately 0.5% of all the people admitted to hospital in South London during 2013/14 met the criteria for being ARFAs and were responsible for 1.5% of all admissions to hospital. Over a quarter of all people admitted to hospital during 2013/14 with an alcohol-related diagnosis met the criteria for being ARFAs, yet were responsible for almost 60% of all alcohol admissions.

Further analyses demonstrated ARFAs are more likely to be older than non-frequent alcohol attenders but younger than non-alcohol related frequent attenders. The mean age of ARFAs was 55.4 years. Regression analyses presented in this thesis indicated that the probability of being an ARFA is greatest at a younger age. Most ARFAs (72.4 %) were male. When controlling for age and other factors, men are almost 4 times more likely to be ARFAs than women. This is perhaps surprising given that the majority of all hospital admissions in 2013/14 for South London were for women, and indeed non-alcohol related frequent attenders are much more likely to be female than male (62.9% of NAFAs were women). However, a much higher proportion of males than females were admitted for alcohol related reasons during 2013/14 (frequent and non-frequent attenders- 70.0% in total were men).

ARFAs were also more likely to live in income deprived wards than the three other patient groups (alcohol-related non-frequent attenders; non-alcohol related frequent attenders and non-alcohol related non-frequent attenders). There were more similarities between the characteristics of ARFAs and non-frequent alcohol-admissions than between ARFAs and non-alcohol frequent admissions.

9.2.2 ARFAs and comorbidities

Chapter 5 investigated what physical and mental health conditions ARFAs present to hospital with, and analysed whether ARFAs are any more complex than other patient groups in terms of their comorbidities and disease status. I tested the hypothesis that ARFAs have more medical and psychiatric comorbidities (i.e. are more complex) than other types of frequent admissions.

In South London during 2013/14, ARFAs predominantly presented to hospital with conditions wholly attributable to alcohol: 3 of the top 5 primary presentations to hospital for ARFAs were alcohol withdrawal, alcoholic cirrhosis of the liver and acute intoxication from alcohol. Together these 3 presentations accounted for 9.3% of all spells for ARFAs.

The most common conditions that ARFAs presented with were physical health conditions as the primary diagnoses, but mental health problems were also common, with 16.5% of ARFAs receiving a mental health diagnosis. Strikingly, there were no mental health diagnoses among the top 10 primary reasons for admission among non-alcohol frequent attenders and only 0.31% of all NAFAs had a primary mental health diagnosis.

End stage renal failure was one of the most common physical primary presentations for ARFAs (3.68% of ARFA admissions).

Considering the total number of comorbidities and severity of comorbidities experienced by ARFAs compared to other groups, ARFAs experience significantly more concurrent medical conditions which are more severe in nature than those experienced by ARNFAs, NAFAs and NANFAs. Application of the Charlson comorbidity index to the four patient groups showed ARFAs to have the highest prevalence of comorbid liver disease, and confirmed the ARFA group to have the highest proportion of patients with any comorbidities. Although counts of comorbidities, with and without weighting, are a crude measure of complexity, these results certainly indicate that ARFAs are medically complex patients and more complex than the other 3 patient groups.

The relationship between mental health conditions and alcohol are well documented. Heavy chronic alcohol consumption increases the risk of mental health disorders including depression, anxiety, psychosis, impairments of memory and learning, and an increased risk of suicide. People who are alcohol dependent are known to have higher levels of comorbidity with other mental health conditions, such as depression, anxiety, post-traumatic stress disorder (PTSD), psychosis and drug misuse, compared to the general population. (NICE, 2011). In terms of physical comorbidities, the physical effects of heavy chronic alcohol consumption are also seen in diseases such as alcoholic cirrhosis of the liver. My results confirmed these links between alcohol and physical and mental health problems and highlighted the frequency of these issues amongst ARFAs. However, it is not clear from this data whether alcohol is causing comorbidities, comorbidities are leading to increased alcohol consumption or whether common predisposing factors increase the risk for both increased alcohol consumption and comorbidities.

As described in chapter 1, ARFAs are a complex group of patients with both physical and mental health comorbidities. My findings also confirm that ARFAs are complex patients, often with more than one alcohol-related problem and a wider range of comorbidities, which are more severe, than for other patient groups. This complexity and severity of diseases amongst ARFAs places a disproportionately large burden on the NHS compared to other categories of patient.

9.2.3 What are the predictors of becoming an ARFA?

This study (chapter 6) tested the hypothesis that diagnostic and socio-demographic characteristics predict transition to alcohol related frequent attendance status.

Having undertaken preliminary exploratory work on a relatively localised cross-sectional South London dataset, subsequent analyses were performed on a national England dataset providing insight into predictors of ARFA and their variation over time. In particular, these analyses tested whether the predictors identified in the South London sample were applicable to data at national level and explored in more depth some of the predictors relating to comorbidity and nature (chronic versus acute) of alcohol diagnosis. In addition, the study examined whether the strength of the predictive relationship changed over time.

A high proportion of ARFAs (almost two-thirds) in 2015/16 had not been classified as an ARFA in the preceding four years. At the other end of the spectrum, 10% of the 2015/16 cohort had been ARFAs every year for the previous four years and this gives insight in to the chronicity of the problem and consequent scale of burden. Hence being an ARFA one year is a predictor of being an ARFA in a subsequent year.

Regression analyses revealed that male gender, greater income deprivation, having a chronic alcohol diagnosis, more than one admission in a year, and having a concomitant mental health diagnosis (other than a wholly attributable alcohol mental disorder diagnosis) were all predictors of becoming an ARFA.

9.2.4 The contribution of alcohol related liver disease (ARLD) to ARFAs

Chapter 7 of this thesis describes a study which tracked the national (England) cohort of ARFAs identified in 2011/12 forwards across a 5 year period to 2015/16 in order to estimate prevalence and incidence of ARLD, as a measure of health outcome for ARFA. Prevalence and incidence rates for ARFAs were compared to those for samples of patients from each of the other 3 patient groups (ARNFAs, NAFAs and NANFAs).

The highest prevalence rates of ARLD were seen amongst ARFAs (3,422 cases per 10,000 people) and ARNFAs (1,811 cases per 10,000 people). ARFAs had the highest incidence of ARLD (1,945 cases per 10,000 people) and this was almost twice that seen for ARNFAs (1,078 cases per 10,000 people). ARFAs also had the highest incidence of end-stage ARLD (1,192 cases per 10,000 people).

By the end of 2015/16, 33% of the ARFAs identified in 2011/12 had a diagnosis of ARLD; and 63% of those ARFAs with ARLD had end-stage disease. All four patient groups showed similar proportions of patients with end-stage- versus non end-stage ARLD, suggesting that conversion rates from ARLD to end-stage ARLD do not happen more frequently or more quickly amongst ARFAs than any of the other patient groups.

Also of note is the unexpected finding that cases of ARLD occurred in NAFA (22.5 cases per 10,000 people) and NANFAs (18.4 cases per 10,000 people), both of which had no recent history of alcohol-related admissions.

9.2.5 Are ARFAs at increased risk of premature death?

Chapter 7 of this thesis describes a study which tracked the national (England) cohort of ARFAs identified in 2011/12 forwards across a 5 year period to 2015/16, comparing rates of death in hospital for ARFAs versus the 3 other patient groups.

Kaplan Meier survival curves show ARFAs to have a lower probability of survival at 5 years than the other patient groups. Age-adjusted five-year survivor function for each of the four patient groups showed ARFAs to have the lowest survival in each age category amongst the four patient groups. Relative hazard of death (number of observed deaths/expected number of deaths) showed ARFAs in the younger age groups (age 44 years and under) to have the greatest excess mortality, followed by ARFAs in the 45-54 year age category, confirming that ARFAs are at increased risk of premature death.

9.2.6 The economic costs to the health service of ARFAs

The majority (63.8%) of ARFAs in 2015 were new ARFAs (with no record of being an alcohol-related frequent attender between 2011-2014). The obverse is that more than a third of ARFAs (36.2%) have a chronic history of alcohol related frequent attending. Even amongst new ARFAs, more than half had had a previous admission for a wholly attributable alcohol diagnosis in the previous 4 years.

Calculation of total and mean occupied bed days (OBDs) allowed the combined effects of average length of stay, mean spells and total number of patients to be compared across groups in the years prior to the index year (2015/16). Comparison of average length of stay and mean spells across groups in the years prior to the index year (2015/16) show small differences between ARFA and NAFA patient groups. However, the combined effects of average length of stay and mean spells as seen in OBDs, demonstrate a more marked difference, with ARFAs accounting for on average more than 10 additional bed days per year per person compared to a NAFA. ARFAs have a longer average length of stay than other frequent attenders, resulting in a significant treatment burden.

Analysis of mean OBDs for the 2011 cohort illustrates a gradual reduction for the ARFA cohort across the years unlike that seen for the ARNFA and NANFA groups. NAFA also see a reduction in OBDs across the 5 years. Within 3 years of the index year the 2011 ARFA cohort had more than halved in number while their average spells had modestly increased.

In terms of estimating the cost of ARFAs, ARFAs had the highest average cost per person over 5 years. Costs were calculated on the basis of the average (all England) cost for an inpatient spell, bearing in mind whether the admission was elective or non-elective, and whether the length of stay was above or below the trimpoint for incurring costs associated with excess bed days.

9.3 Interpretation of the findings

This section discusses the interpretation of each of the studies' findings in response to the research questions posed.

9.3.1 Do ARFAs account for a disproportionately larger share of inpatient bed days than other patient groups?

My findings from the longitudinal national study of alcohol related hospital admissions in England reported the numbers of ARFA patients each year between 2011-2016 and together with the findings of the cross-sectional study of South London, confirmed that ARFAs do account for a disproportionately larger share of inpatient beddays than other patient groups.

Analysis using longitudinal national hospital admissions data considered the combined effects of average length of stay and mean spells for patients in the years pior to, and the years following, becoming an ARFA. ARFAs account for on average more than 10 additional bed days per year per person compared to non-alcohol related frequent attenders, suggesting that alcohol is an important factor in accounting for this additional burden. Results showed that ARFAs have a chronic history of alcohol related admissions, and ARFA status itself is chronic in nature. This is likely to reflect the chronic nature of alcohol related disease contributing to the burden. The additional bed days for ARFAs were accounted for by longer average lengths of stay for ARFAs than other patient groups (rather than greater numbers of admissions alone). This increase in average length of stay is likely to reflect contributions from one or all of the following factors: increasing complexity of clinical condition, increasing severity of chronic illness, increasing complexity of social situation resulting in delayed discharge seen for ARFAs compared to other patient groups.

Reasons for the drop in ARFA activity following the 2011/12 index year could be due to deaths within the cohort, or improvement in health status within the cohort, or access to treatment elsewhere, however the increase in mean OBDs per person suggest that the remaining members of the cohort are spending more time in hospital each year and therefore mortality may play a more prominent role in driving this decrease in activity amongst the ARFA cohort.

Equally ARFAs could be accessing treatments elsewhere such as local community based alcohol services or assertive outreach services and activity in these types of services is not included within HES.

From the literature it is known that people with chronic conditions attributable to alcohol place a disproportionately large burden on A&E departments (Phillips et al, 2016) but until now, the scale of the extent of the problem in relation to inpatient admissions in England has not been known, although services are now being implemented in England to address the problem (Fincham-Campbell et al, 2018).

9.3.2 Do ARFAs have more medical and psychiatric co-morbidities (i.e. are more complex) than other types of frequently admitted patients?

The most common conditions that ARFAs presented with were physical health conditions as the primary diagnoses, but mental health problems were also common, with 16.5% of ARFAs receiving a mental health diagnosis. Strikingly, there were no mental health diagnoses among the top 10 primary reasons for admission among non-alcohol frequent attenders and only 0.31% of all NAFAs had a primary mental health diagnosis. This suggests that mental health conditions are more linked to alcohol rather than frequent attending per se. These findings are similar to those of Neale et al (2017) who found that almost one third of alcohol related frequent emergency department attenders had a formal mental health diagnosis, others reported psychiatric symptoms but had not been formally diagnosed, and almost all participants spoke of multiple chronic physical health problems as a result of their drinking. The high rate of presentation of mental health conditions as the primary reason for admission to hospital for ARFAs suggests that these patients may not have engaged with community based mental health services, resulting in admission to hospital being the only option to manage their immediate crisis. There may be multiple reasons for lack of engagement: alcohol intoxication could be masking mental health symptoms resulting in missed diagnoses; A&E or community practitioners may have missed opportunites to diagnose underlying mental health problems, focusing only on the more immediate alcohol problem for example prioritising detoxification or because of stigma; or attitudes of ARFAs may prevent them from accessing services. These interpretations are supported by the literature (Drummond et al, 2017; Neale et al, 2017).

3 of the top 5 primary presentations to hospital for ARFAs were alcohol withdrawal, alcoholic cirrhosis of the liver and acute intoxication from alcohol. Together these 3 presentations accounted for 9.3% of all spells for ARFAs.By definition ARFAs had to have at least 1 wholly attributable alcohol diagnosis amongst 1 of their 3 (or more) admissions during the year although it did not have to be the primary presenting condition. The fact that for many ARFAs a wholly attributable alcohol diagnosis was the primary reason for admission emphasises that the burden placed on services by ARFAs is largely a direct result of alcohol, rather than alcohol only partially causing the problem or indeed alcohol problems being an incidental finding on admission. Neale et al’s 2017 study, which reported findings from in-depth interviews with 30 alcohol related frequent attenders to London emergency departments, found that reasons given for continued heavy drinking among the frequent attenders included attempts to self-medicate physical, mental health and social problems; and to be able to perform normal activities of daily living such as getting dressed.

An unexpected finding was that end stage renal failure was one of the most common physical primary presentations for ARFAs (3.68% of ARFA admissions), even though this diagnosis has not previously been directly or partially attributed to alcohol (Jones and Bellis, 2013). There could be several explanations for this finding. Firstly, acute renal failure is known to be a common complication in patients with decompensated cirrhosis and acute kidney injury is a strong predictor of in-hospital mortality in patients with cirrhosis (Angeli et al, 2015). Differentiating between patients with acute and chronic renal failure in patients with ascites and cirrhosis may be less clear-cut due to problems with oliguria and diuretic treatment (Angeli et al, 2015) so this may be a diagnostic issue. Secondly, it could be that the frequency with which patients with chronic renal failure have to attend hospital for treatments such as dialysis, places a large number of them in the frequent attending category, with alcohol being a coincidental diagnosis. Further, this could be a coding issue where attendance for dialysis has been recorded as an admission rather than an attendance. While the precise reasons for this finding are unclear, it warrants further research.

Findings of chapter 7 also affirm that ARFAs are more complex patients. Literature on the links between alcohol consumption and ARLD also support this argument (Hazeldine, Hydes and Sheron, 2015). Furthermore, analyses of hospital activity before and after diagnosis of ARLD showed that 30-45% of patients who went on to develop ARLD had alcohol-related emergency admissions between 2 and 6 years prior to ARLD diagnosis and 77% had contact with a hospital for any reason (including non-alcohol-related) in the year prior to diagnosis (Currie et al, 2015), emphasizing the “silent nature” of ARLD as described by Hazeldine, Hydes and Sheron, (2015). Alternatively, ARFAs may be more predisposed to presenting later than other patients, due to missed diagnoses such as symptoms of acute intoxication or mental health symptoms masking their underlying diagnosis; or their own attitudes towards health services resulting in reluctance to present, for example, based on previous negative experiences of stigma. The findings presented demonstrate that ARFA status precedes ARLD and is potentially a predictor of ARLD in its own right. ARFAs could potentially be an easily identifiable (though not necessarily easy to reach) target group at which preventative interventions for ARLD could be targeted.

9.3.3 Is there is a higher incidence of ARFAs in the most deprived geographical areas compared to the least deprived?

Study 1 found that ARFAs are more likely to live in deprived wards in South London. A multivariable regression model including income deprivation showed a small but highly statistically significant relationship between deprivation and alcohol admissions. These findings indicate an important link between low socio-economic status and ARFA. These findings also indicate that other additional factors (beyond those included in the model) influence alcohol-related admissions.

These findings are consistent with those found in the literature review regarding alcohol admissions being linked to low socio-economic status (Kent and Yellowlees, 1994; McCormack et al, 2013; Hughes et al, 2013; Schomerus et al, 2011; Locker et al, 2007; Skinner, Carter and Haxton, 2009; Mannix et al, 2014) and reflected in later studies (Neale et al, 2017).

My findings are also consistent with the literature indicating that other factors are important influences on alcohol-related admissions, such as regular criminal justice involvement (Holland and Evenson, 1984), unemployment (Slater and Linn, 1982; Booth et al, 1991; Fagan et al, 2014; Ponzer, Johansson and Bergman, 2002), ethnicity (Fagan et al, 2014; McCormack et al, 2013), little engagement with existing specialist services (Passetti et al, 2008), divorced/separated (Holland and Evenson, 1984), presence of certain biochemical markers at admission, and drinking levels (Ponzer, Johansson and Bergman, 2002).

With the exception of ethnicity, these other characteristics are not recorded within HES data. To include these additional factors in the model would require the use of additional data sources linked to HES data. Ethnicity is included within HES data but is known to poorly reflect true ethnicity status in terms of data quality (Mathur et al, 2014).

In relation to the impact of socioeconomic status over the lifecourse, findings from the 1958 British Birth Cohort Study, following the lives of 17,000 people born in England, Wales and Scotland during a single week in March 1958, found that low socio-economic status during childhood was associated with an increase in problem drinking in midlife (Caldwell et al, 2008). In the same study and another study (Batty et al, 2008) cumulative disadvantage over the lifecourse was found to be the strongest predictor of drinking patterns in the study: disadvantage in childhood and adulthood resulted in an increased risk of midlife problem drinking. Across all ages, men with low socioeconomic status reported binge drinking more often than those of higher socioeconomic status; whereas for women, at younger ages lower socioeconomic women were less likely to binge drink than higher socioeconomic status, but at older ages for women, the reverse was true (Jefferis, Manor and Power 2007). In terms of the harm from alcohol, people with lower income, education or occupational status are more likely to die or suffer morbidity as a consequence of their alcohol use (Makela, 1999; Romlesjo and Lundberg, 1996; Van Oers et al, 1999; NHS Health Scotland, 2018) and this disproportionate harm experienced by disadvantaged populations is known as the alcohol harm paradox (Katikreddi et al, 2017; Bellis et al, 2015). It is therefore not surprising that those admitted to hospital for alcohol problems are more likely to be of lower socioeconomic status.

9.3.4 Can multiple medical and socio-demographic characteristics predict transition to alcohol related frequent attendance?

My findings showed that the mean age of ARFAs was 55.4 years, which was older than findings by Baune et al (2005) who studied the alcohol burden amongst emergency room attendees in Germany where patients were most likely to be aged between 31-50 years, and McCormack et al (2013) who studied homeless alcohol dependent adults and found a mean age of 46.5 years. The findings from study 1 and those of Baune and McCormack could all broadly be described as fitting in to the “early-middle age category”. Regression analyses presented in this thesis indicated that the probability of being an ARFA is greatest at a younger age, yet we know most ARFAs presenting to hospital tend to be in their mid-50s. This may reflect differences in the type of alcohol diagnoses that a person has: younger males may be more likely to present much more frequently with acute intoxication at a young age to the emergency room whereas older patients may present with the chronic effects of alcohol use such as liver disease or pancreatitis and be admitted to hospital. This hypothesis was explored in more depth in chapter 5. Many studies report that alcohol consumption decreases with age (Britton et al, 2015; Fillimore, 1987; Kerr, Fillmore and Bostrom, 2002; Moos et al, 2009; Fillimore et al, 1991) though older drinkers typically consume alcohol more frequently than other age groups (WHO, 2014). With increasing age, there is some evidence of reduced tolerance for alcohol, resulting in a high burden of unintentional injuries such as falls and these may be a significant reason for admission, which is investigated in chapter 5. Looking at age and burden of alcohol on health services in the UK, during 2013/14, men aged 45–64 years old had the highest rate of emergency admissions compared to other groups (1,126.0 per 100,000 population) and this may reflect the chronicity of alcohol-related diagnoses and the contribution of alcohol to many long-term conditions that are more prevalent in older age groups (Currie et al, 2015). Findings from South London indicate that ARFAs form a high proportion of these emergency admissions.

Alcohol is known to impact differently on males and females as illustrated by differences in mortality from alcohol between males and females (WHO, 2014). The difference in burden between males and females in terms of hospital admission and mortality as shown in other studies (WHO, 2014) may largely be explained by different patterns of consumption, reflected in population prevalence rates for alcohol dependence being higher for males (1.71%) than females (0.63%) (Pryce, 2017). Therefore, it follows that higher levels of consumption by males lead to higher levels of morbidity and consequently more admissions, consistent with the finding of males being more likely to be ARFAs than females.

Regression analyses revealed that male gender, greater income deprivation, having a chronic alcohol diagnosis, more than one admission in a year, and having a concomitant mental health diagnosis (other than a wholly attributable alcohol mental disorder diagnosis) were all predictors of becoming an ARFA and these findings are supported by previous literature (Slater and Linn, 1982; Siegel, Alexander and Lin, 1984). However, all these factors were also associated with alcohol related non-frequent admissions during the same period and as such these factors could not distinguish between a person becoming an alcohol related frequent or non-frequent admission. Nevertheless, age, total number of inpatient admissions and having a chronic alcohol diagnosis were more strongly associated with being an ARFA than an ARNFA.

It was hypothesised that certain variables would be stronger and earlier predictors of becoming an ARFA than others and this was studied by comparing odds ratios over time for becoming a new ARFA. Analyses using different combinations of inpatient data years showed that the only odds ratios which were significantly different between 2011/12 only and 2011/12-2013/14 combined were: being income deprived, having a chronic alcohol diagnosis, and having 1 or multiple alcohol admissions over time. As there was little change in odds ratios over time for all the other variables, this suggests that predictors of becoming a new ARFA are evident as early as 4 years prior to being first identified as an ARFA. But we know from earlier findings in this study that these same four variables are unlikely to clearly distinguish an ARFA from an ARNFA so using them as a predictive tool in their own right is likely to be unreliable as a method of early detection. The fact that having more than 1 admission in a year (but not 3 admissions or more) increases the likelihood of becoming an ARFA, suggests that the rise in admissions in the years prior to becoming an ARFA are an indication of an increasing risk of becoming an ARFA.

Using the same data but analysing the effects of each year's data alone, reduced the effects of having a chronic alcohol diagnosis, having more than 2 alcohol admissions in a year and having more than 3 admissions for any cause in a year. This suggests that censoring of data may be an issue: when 4 years of data are combined there is more chance that these events could happen; whereas looking at data for 2011 alone, gives less opportunity for these events to happen. However, only considering an individual years' data for indicators of chronic alcohol disease is not realistic in the clinical setting. A person who had a chronic alcohol diagnosis in 2013, may have had that diagnosis in 2012, 2011 and prior to that. Furthermore, there may be additional diagnoses not recorded in the HES entry in 2013, but were recorded in 2012 and which could still be important in terms of the patient's overall clinical status and outcomes, but would not have been taken into account in this analysis because it only considered one year of data.

From the literature, we know that moderate to excessive drinking, moderate to heavy tobacco use, socio-economic status, and marital status are all strong predictors of first admission to hospital for alcohol (Lawder et al, 2011). The systematic review in this thesis identified a number of characteristics associated with readmissions or multiple alcohol related admissions: younger age of onset of first problem drinking, source of referral to alcohol treatment, greater number of arrests due to alcohol, marriage breakdown (Holland and Evenson, 1984); drinking patterns and behaviours and ability to return to work (Fagan et al, 2014; Ponzer, Johansson and Bergman, 2002); biochemical markers (Ponzer, Johansson and Bergman, 2002); established chronicity, younger age, living alone (Siegel, Alexander and Lin, 1984); psychiatric co-morbidity, less stable family background and unemployment (Slater and Linn, 1982). Previous treatment for alcohol dependence was also cited as a predictor (Booth et al, 1991). Of these characteristics, age, psychiatric comorbidity and presence of a chronic alcohol diagnosis are recorded within HES. No previous studies have specifically looked at predictors of frequent admissions for alcohol-related conditions.

9.3.5 Do ARFAs have poorer health outcomes compared to other frequent attenders including shorter survival?

Kaplan Meier survival curves show ARFAs to have a lower probability of survival at 5 years than the other patient groups and young ARFAs (aged 44 years and under) suffered the greatest excess mortality of all patient groups and ages. It can therefore be interpreted that ARFAs have poorer health outcomes overall than other patient groups.

As previously considered in section 9.3.1 , ARFAs are noted to have longer lengths of stay on average for each admission than other patient groups, and one possible explanation for this supported by this finding regarding overall survival is that ARFAs have poorer health outcomes and their clinical conditions are more complex to treat than other patient groups, thus they longer lengths of hospital stay.

Given the high rates of ARLD amongst ARFAs it may seem surprising that ARFAs have as much as a 75% likelihood of being alive at 5 years, however, the Kaplan Meier curve only includes deaths in hospital and not those which occurred outside hospital. This 5-year probability of survival is therefore an underestimate of overall mortality for ARFAs (and all other patient groups). It has previously been estimated that approximately 50% of all deaths occur in hospital (McCormick, Pearson and White, 2016). Given the high level of comorbidity amongst ARFAs, in fact the majority of ARFAs may indeed die in hospital due to the severe nature of their illness. Taking both these factors into account, the probability of 5-year survival for ARFAs would be lower than the 0.75 estimate once deaths outside of hospital are taken in to account, though this may actually result in proportionally more deaths and lower survival for the

3 other patient groups (ARNFAs, NAFAs and NANFAs) than for ARFAs because most ARFA deaths occur in hospital anyway. The exclusion of deaths outside of hospital, and the inclusion of deaths for ARFAs for all causes (not just cirrhosis), may explain why my estimate of 0.75 likelihood of 5-year survival is lower than other published rates e.g. survival rates for community patients with cirrhosis are 0.84 at 1-year and 0.66 at 5-years, reducing to 0.55 at 1-year and 0.31 at 5-years after hospitalisation (Ratib, 2014).

I was unable to analyse the causes of death for ARFAs from the HES data (linked mortality data would make this possible). From the literature, the most common causes of death related to alcohol globally are cardiovascular disease and diabetes, accounting for 33.4% of alcohol-related deaths, unintentional injuries accounting for 17.1% of alcohol-related deaths, followed by gastrointestinal disorders including ARLD accounting for 16.2% of alcohol-related deaths (WHO, 2014). Cardiovascular disease, diabetes and unintentional injuries are all conditions which are partially attributable to alcohol and no subcategories of those diagnoses are wholly attributable to alcohol, unlike alcohol-related liver disease within gastrointestinal diseases. Women with alcohol-use disorder experience higher death rates from liver cirrhosis, mental disorders and injuries than men with alcohol-use disorder (Roerecke, 2014). Although I was unable to analyse cause of death, it is not unreasonable to assume that the same causes of death described by Roerecke would also be seen amongst the ARFA group.

Cases of ARLD were found in NAFA and NANFA patient groups, both of which had no recent history of alcohol-related admissions. This could be due to late onset of alcohol-related harm following an earlier life history of harmful drinking, or this could reflect undiagnosed alcohol problems during more recent hospital admissions, or the first admission could be for ARLD. Literature suggests that reduction in alcohol intake can reduce risk from alcohol-related harm (Mann, 2017) perhaps pointing more towards the undiagnosed alcohol problems during hospital admission being the more likely explanation. Screening for alcohol during a hospital admission is discussed later in this chapter.

Alcohol related liver disease (ARLD), which includes the diagnoses: alcoholic fatty liver, alcoholic hepatitis and alcoholic cirrhosis, is part of a growing epidemic of liver disease in the UK and ARLD will soon overtake ischaemic heart disease in terms of years of working life lost (Williams et al, 2018). ARLD can take over 10 years to manifest, firstly as alcoholic fatty liver then fibrosis leading to cirrhosis then acute or chronic liver failure, following prolonged exposure to harmful levels of alcohol (Hazeldine, Hydes and Sheron, 2015). Eighty percent of liver disease patients present as an emergency either because of decompensated cirrhosis or alcoholic hepatitis (Hazeldine, Hydes and Sheron, 2015).

The higher incidence of ARLD amongst ARFAs compared to ARNFAs suggests that ARLD appears to be associated with alcohol-related frequent admissions but many factors may also contribute to this.

One explanation could be that because ARFAs have more admissions than ARNFAs there are more opportunities to test for and diagnose ARLD, thus the difference in incidence rates is a reflection of different diagnostic rates. But earlier chapters (chapter 2, comorbidity) revealed that the most common reasons for admissions as an ARFA are not just for ARLD, suggesting that ARLD itself does not result in ARFA status: other non-alcohol health-related activity is occurring in addition to an alcohol diagnosis, resulting in ARFA status. When comparing incidence rates of ARLD across the four groups, patients were categorised by alcohol and frequent attendance in the year preceding any new diagnoses of ARLD, suggesting that having ARLD does not itself result in becoming an ARFA, but is a late sequela. Even the onset of end-stage ARLD does not seem to impact on becoming an ARFA: transition to ARFA has already happened. In other words, the frequent admission aspect of the ARFA is not necessarily all directly due to alcohol, but caused by a wide range of comorbidities, in addition to the alcohol problem. Subsequently the alcohol aspect of the ARFA becomes severe enough in nature (i.e. alcohol intake is at high enough levels over a prolonged enough time period) that it results in a higher rate of serious harm, requiring further additional hospitalisation.

The high rates of ARLD and end-stage ARLD amongst ARFAs are of particular concern, as many patients will not be candidates for potentially curative liver transplant because of their clinical comorbidities and other social factors.

9.3.6 Does the cost of health service usage by ARFAs represents a disproportionately large burden to the NHS compared to other service users?

ARFAs have a longer average length of stay than other frequent attenders, resulting in a significant treatment burden. Comparison of average lengths of stay for chronic ARFAs and new ARFAs showed no significant difference in length of stay, so the shift in average length of stay seen for ARFAs and ARNFAs in the year prior to the index year is unlikely to be due to new ARFAs joining the cohort.

Again, as reflected in the 2015 cohort, it seems to be the increase in average length of stay for ARFAs that has the biggest influence on mean OBDs per person. This increase in average length of stay is likely to reflect contributions from one or all of the following factors: increasing complexity of clinical condition, increasing severity of chronic illness, increasing complexity of social situation resulting in delayed discharge.

Reasons for the drop in ARFA activity following the 2011/12 index year could be due to deaths within the cohort, or improvement in health status within the cohort, or access to treatment elsewhere, however the increase in mean OBDs per person suggest that the remaining members of the cohort are spending more time in hospital each year and therefore mortality may play a more prominent role in driving this decrease in activity amongst the ARFA cohort.

Equally ARFAs could be accessing treatments elsewhere such as local community based alcohol services or assertive outreach services and activity in these types of services is not included within HES. From the literature, a pilot study of assertive community treatment for patients with alcohol dependence demonstrated a reduction in inpatient hospital stays for the treatment group (Drummond et al, 2017). Similarly, an assertive outreach treatment (AOT) service for alcohol frequent attenders in Salford, UK demonstrated a 66% reduction in inpatient hospital admissions (151 admissions prior to the intervention to 50 admissions, in a cohort of 54 ARFAs) and reduction in emergency department attendances of more than half (Hughes et al, 2013). If ARFAs were accessing services similar to assertive community treatment for alcohol dependence or AOT, then it could be feasible that the reduction in OBDs seen between 2011-2015 for the 2011 ARFA cohort is merely the shift in care burden from hospital inpatient services moving to community based services, rather than anything to do with the 2011 cohort getting smaller (and hence reducing inpatient stays) due to deaths in the cohort.

In study 5 presented here, within 3 years of the index year the 2011 ARFA cohort had more than halved in number while their average spells had modestly increased. Using the Salford study AOT figures (Hughes et al, 2013), if each of the 76 assertive outreach treatment services in England (Fincham-Campbell et al, 2018) had on average 54 patients as their caseload, this means that potentially 4,104 patients in England could be receiving AOT at any one time. If each of the 4,104 patients stopped being admitted to inpatient hospital services altogether, based on average spells and lengths of stay per person during the 5-year study period, this would equate to 241,320 fewer OBDs across the 5-year study period, equivalent to a 7.9% reduction in overall OBDs for the 2011 cohort in study 5. In fact, study 5 reported a reduction in 31,386 people and 889,659 OBDs across the 5-year period, so take up into assertive outreach treatment, even if offered at all 76 services in England, cannot explain the full reduction in numbers seen for the 2011 cohort, and other factors such as death or remission must also play a part.

It is also know from the literature that a substantial proportion of dependent drinkers are known to recover without treatment (Rumpf et al, 2006) and estimates range from 46% of men with alcohol abuse (Hasin, Grant and Endicott, 1990) to 82% heavy and dependent drinkers (Rumpf et al, 2006) remitting without treatment. In study 2, investigating ARFA comorbidities, 25.4% of males and 26.5% of females were documented as having alcohol dependence. Therefore, if the upper estimate of natural remission amongst dependent drinkers also applies to the dependent drinkers amongst ARFAs (estimated as 13,503 people, based on 26% of 51,934 initial 2011 ARFA cohort), we can assume that 82% or 11,072 people would have got better without treatment anyway. Given the complexity of ARFAs from a mental and physical health point of view as described in study 2, it may well be too grandiose an assumption to make that ARFAs could recover without any clinical input.

The combined estimates of 4104 people being treated in alternative service settings and 11,072 people remitting without treatment anyway, accounts for 15,176 people in total. Study 4 reported 7881 deaths in hospital for ARFAs occurring in the 2011 cohort. From 2011 to 2015 the 2011 ARFA cohort reduced by 31,386 people, but only 23,597 people are accounted for after death in hospital and through estimates of natural remission and receiving treatment in alternative settings, leaving 7,789 ARFAs unaccounted for. This could mean that 7,789 ARFAs died at home (and this would support the estimates of 50% of all deaths taking place in hospital made by McCormick, Pearson and White, 2016 also applying to ARFAs). An alternative explanation is that 7,789 ARFAs subsequently had no contact with health services after 2011, this latter assumption being supported by previous literature (Passetti et al, 2008).

ARFAs had the highest average cost per person over 5 years at £38,189, followed by NAFA at £32,714, ARNFAs £9837 and NANFAs £6743. Taking into account the size of each of the four patient groups on a national basis, extrapolating these figures to include all patients admitted in England in 2011, shows that the cost for 1 year for all ARFAs was £764m on inpatient admissions, which was higher than the costs for all other alcohol (ARNFA) admissions at £392m, but lower than the total costs for NAFAs (£14bn) and NANFAs (£11bn). There are two interesting elements to these findings. Firstly, that although nationally the number of ARNFAs outweighs ARFAs by almost 3:1, the overall cost of the ARFA group is almost double that for ARNFAs. As previously discussed, this is because ARFAs have more frequent admissions than ARNFAs and have longer lengths of stay, due to their complexity. ARFAs can therefore be described as being higher cost and higher need than other (non-frequent) alcohol admissions.

Secondly, ARFAs made up 0.7% of all patients in the 2011 national cohort, ARNFAs 1.9%, NAFAs 15% and NANFAs 82.4%. But in terms of share of total inpatient costs in 2011, ARFAs were 2.8% of costs, ARNFAs 1.5%, NAFAs 53.7% and NANFAs 42.1%; showing ARFAs to be the cost intensive patient group with a ratio of % cost:% patients of 4.0; followed by NAFAs at 3.6; ARNFAs at 0.8; and NANFAs at 0.5.

The costs for ARFAs and ARNFAs only take in to account the costs associated with admissions for people who had a wholly attributable alcohol diagnosis. If partially attributable conditions were also taken in to account, a much greater share of the overall inpatient NHS costs would be borne by ARFAs and ARNFAs than currently. ARFAs would have the greatest increase in costs on account of not only including the additional people with partially attributable alcohol-related conditions but also their non-alcohol related admissions as well (the definition of ARFA used was for 3 admissions one of which must be alcohol-related). So for every 1 additional partially-attributable condition allocated to an ARFA, there would be at least an additional 2 alcohol- or non-alcohol related admissions as well. Costs presented only take in to account the cost of the inpatient stay and do not take in to account mental health inpatient, community health, ambulance, outpatient or emergency department costs.

9.1 Strengths and limitations

9.1.1 Systematic review

Strengths of the systematic review include the use of broad search criteria for the terms relating to alcohol use/dependence, multiple terms for frequently admitted patients and also included searches for approaches to management. Despite these broad terms relatively few papers were found and less still included in the study. No systematic reviews, meta-analyses or randomised controlled trials directly comparing the characteristics of ARFAs with other frequent attenders were found. No papers included the term "alcohol related frequent attenders" within the title and only one study used routinely collected data (HES). Only papers in English language were included.

9.1.2 Analyses of South London data

One of the strengths of these studies was that they used a large sample and cases and controls came from the same geographic area, reducing the potential for bias. Only a relatively small amount of data was lost as a result of data cleaning. Care has been taken to include all diagnoses within the analyses of CIPS and spells from every diagnostic field of every FCE, ensuring that alcohol-related diagnoses were not missed. The definition used for an alcohol-related admission and alcohol-related frequent attender were purposefully broad (only one of the minimum of three admissions needed to be classed as a frequent attender had to have a wholly attributable alcohol-related diagnosis) because having to come to hospital for an alcohol-related cause at all probably indicates high alcohol consumption anyway.

One of the major strengths of the comorbidities study (chapter 5) was that it included an in-depth exploration of additional diagnoses beyond just primary and secondary diagnoses as recorded in HES, for a relatively large population. Furthermore, the study was able to look specifically at comorbidity for this group of patients. Although alcohol-specific and alcohol-related hospital admission rates are published by Public Health England (PHE) regularly, their broad and narrow definitions for alcohol-related admissions only include diagnoses found within the first two diagnosis categories within HES. Only their alcohol-specific admission rates look at all diagnostic categories. Therefore, the comorbidities study is likely to correctly identify more patients as ARFAs and ARNFAs than PHE would, and equally is more likely to uncover a higher number of comorbidities than would be found by just considering primary and secondary diagnoses.

Another strength of these studies is the definition used to determine alcohol admissions. It only includes wholly attributable alcohol conditions, which means that impacts of alcohol can be directly assessed. However, with this comes a limitation which is that admissions for partially attributable alcohol conditions are not counted and there may be a large unknown population of ARFAs admitted with one or more partially attributable alcohol conditions who get attributed to the NAFA or NANFA categories. ARFA burden is therefore likely to be underestimated.

Other limitations of this study include the measure of deprivation used is not personal to the individual but represents the level of income deprivation within the lower super output area that the person lives in. Furthermore, the measure of deprivation linked to the hospital episode is populated with data from 2004, which in turn originates from the 2001 census and may therefore be lagging by up to 12 years behind the actual scenario in 2013/14. Within a London borough, 12 years is a long enough period of time for an area to undergo gentrification and attract a different resident population with very different income profiles.

Limitations of the comorbidities study include that analysis was carried out at a local level, and results are therefore not necessarily generalisable to other parts of the UK or other countries. Furthermore, the count of comorbidities used was a crude measure of the range of morbidities the person may be experiencing on admission. It is not a measure of clinical burden and makes no attempt to compare the severity or chronicity of one disease with another. The use of the Charlson comorbidity index provided a good overview of disease burden, however it was originally designed for a different purpose. It has nonetheless been used in a similar way to here in other studies such as for case-mix adjustment.

9.1.3 Analyses of national data

One of the main strengths of studies 3, 4 and 5 was the use of a very large sample: the England national dataset provides information on all inpatient admissions to NHS hospitals in England for the 5 years included in the studies. The dataset is rich with details of not just primary presenting problem but up to 19 additional secondary diagnoses coded from a single dictionary (ICD10), procedures underwent, lengths of stay, nature and location of care, sociodemographic data and discharge data. The dataset is very complete because it is the dataset used to calculate payments to hospitals for the care they have delivered: it is therefore in the interests of hospitals to complete the data accurately and return it to NHS Digital for collation. Not only is the data likely to be very complete for all NHS admissions, since only 11% of the UK population are estimated to have some form of private health cover (Kingsfund, 2014), and of those who have it only a very limited number will have comprehensive enough insurance to cover them for emergency admissions and chronic illness, it is likely that almost all of the admissions to hospital both private and NHS for ARFAs, especially those of an emergency nature and those for ARLD, are included within the HES inpatient dataset.

Another strength of the large national dataset is that cases and controls came from within the same dataset, reducing the potential for bias. By drawing patient group samples from the national (England) hospital records this meant that the entire ARFA populations of 2011/12 and 2015/16 could be included as well as the entire ARNFA populations. There is therefore no doubt that these groups are representative of the all-England picture and that study 5 provides accurate estimates of the prevalence and incidence of ARFAs. Even if patients relocate within England, their hospital data will still be captured and linked to their record which adds to the dataset's completeness. The use of a 5-year longitudinal dataset allowed new ARFAs (those with no previous history of being an ARFA in the 4 preceding years) to be distinguished from chronic ARFAs. Together with the longitudinal nature of the data this identification of new ARFAs allowed predictors to be looked at in the years prior to becoming an ARFA and this is novel. This is also the first study that I am aware of that attempts to document the number of new ARFAs in England each year, as well as give insight into health service usage for chronic ARFAs. This is also the first study to calculate costs for ARFAs over a 5-year period, and directly compare those estimated costs with those for other alcohol-related non-frequent admissions and other non-alcohol related frequent admissions.

Up to now little has been known about the mortality of ARFAs. There have been few studies looking at alcohol use disorders and cause specific mortality, and of those very few are based on UK populations (Roerecke, 2014). A major strength of study 4 therefore is the investigation of mortality amongst ARFAs. Analysing England-wide mortality data on in-hospital deaths avoids problems associated with the variability of measuring hospital-based mortality rates (Shahian, 2010). By only including wholly attributable alcohol diagnoses within the definition of an alcohol admission, the burden of alcohol on admissions can be directly attributed (unlike for partially attributable admissions). Another advantage of this is the detection of alcohol-attributable outcomes such as ARLD in patients who had not been recorded as having a previous alcohol-related admission, which helps to calculate the extent of under-reporting, under-recording or under-diagnosing of conditions during admissions. The use of longitudinal data allows survival probabilities to be calculated over a 5-year period as opposed to a 1 year snapshot of deaths.

A limitation of the study into predictors of ARFA was that predictors were limited to those fields contained in the HES dataset. We know from the literature that other characteristics influence alcohol and frequent attending, such as marital status, employment, contact with the criminal justice system (Rosenblatt and Mayer, 1974; Holland and Evenson, 1984; Fagan et al, 2014). It would only be possible to include these predictors by undertaking data linkage between datasets.

One of the main limitations of the mortality study is that only deaths in hospital are included, not deaths outside the hospital. Therefore, these rates are likely to be an underestimate by as much as 50% (McCormick, Pearson and White, 2016) for each category of patient. This limitation could be addressed through the addition of linked ONS mortality data to the dataset. Another limitation is missing data: almost 20% of the data included erroneous or missing admission dates so had to be excluded from the mortality analysis. Therefore, the rates presented are likely to be an underestimate of mortality, however the underestimate is likely to be consistent across all patient categories.

Costs were based on average inpatient spell costs and average lengths of stays calculated for each of the 4 patient groups rather than individual costs of each patient within a group. Therefore, the main limitation of the study is that the estimate of costs may be an underestimate given that other results reported in this thesis suggest ARFAs to be more complex than other patient groups (and therefore likely to incur higher costs through HRG).

9.4 Recommendations for further research

Based on the findings presented, further development of models to aid clinical decision making for practitioners treating ARFAs as they present, and further investigation of the outcomes for ARFAs are recommended and discussed in more detail below. In addition, recommendations for the investigation of deaths in hospital for ARNFAs is recommended.

9.4.1 Risk stratification of ARFAs to aid clinical decision making

The term ARFA is a relatively broad term to describe a very heterogenous group of patients, as shown by the data presented. ARFAs include patients with a wide spectrum of illnesses and different stages of illness, from the repeat acutely intoxicated attender to the chronically readmitted ARLD patient. Stratification of ARFAs based on comorbidity would therefore be useful to the practitioner in recommending appropriate onward referral and treatment. Based on the predictors of being an ARFA identified to date the development of a model that generates a ranked list of patients prioritised by risk of multiple admissions from alcohol, to be used in real-time, populated by routinely collected data from electronic patient records in the hospital setting, could prevent future readmissions. Ultimately this could make it possible to identify ARFAs who could be treated in an alternative non-inpatient setting, thus identifying “avoidable” admissions. A reduction by 10% of non-elective ARFA admissions in a year would equate to NHS savings of £17.9m annually.

Characteristics which are not available within HES data for use in the modelling but have been shown by previous studies to be associated with alcohol related frequent attending and admissions include various biochemical markers, marital and employment status and drinking levels. Future research could include linking additional data to HES in the model from surveys and audits of patient records.

9.4.2 Further investigation of ARFA pathways and outcomes

The studies presented here have revealed that transition to ARFA status often occurs before diagnosis of ARLD. This prompts the question, what is the clinical picture for ARFAs when they first become ARFAs and what disease processes are happening between being diagnosed as an ARFA and developing ARLD? More detailed ARFA disease pathway work would help answer this question, and would be facilitated by mapping the transitions of individual patients across a 5 or 10-year period of time.

The data also suggest links between ARFA status and renal disease. The reasons for the link are not clear from the data presented. Renal disease could be partially alcohol-attributable; or chronic renal patients may increase their alcohol consumption as a result of their disease, to “self-medicate”; or the link maybe something else such as serious mental illness (higher levels associated with alcohol and possible links between treatments for serious mental illness, e.g. lithium and development of renal disease (Iwagami et al, 2018). This deserves further exploration as may reveal an area of alcohol-related morbidity yet to be fully investigated.

Outcomes apart from ARLD for ARFAs also require further analysis. In particular mental health outcomes, and the burden of ARFA’s mental health requirements on the NHS should be calculated. This is particularly topical, where mental health services currently focus on treating those with severe mental illness, rather than those with common mental disorders such as anxiety, depression and other diagnoses such as personality disorder. Addiction services tend not to be able to cater for these mental health diagnoses either and so patients with these diagnoses plus an alcohol problem are not well served. The extent of the problem has not been fully assessed, and if for example such an exercise identified that 10% of non-elective inpatient admissions for ARFAs could be avoided if other services were able to serve those needs of patients, this could potentially release £17.9m annually from the NHS' inpatient care budget.

Cause of death for ARFAs remains uninvestigated as, despite best efforts, I was unable to access linked HES-ONS mortality data within the timescales of this project. A report on deaths from alcohol related liver disease in 2013 (NCEPOD, 2013) did not specifically include reference to alcohol related frequent attenders. Exploration of pathways to death for those with alcohol use disorders has been highlighted by other authors as a priority and current research in this area considered to be rudimentary (Roerecke and Rehm, 2014).

9.4.3 Deaths within 30 days for ARNFAs

An unexpected finding from survival analysis was the high mortality rate for ARNFAs within 30 days of hospital admission compared to other patient groups including ARNFAs. This warrants further investigation, by clinical audit of patient notes and through data analysis at scale. With the addition of ONS mortality data, cause of death could be investigated.

9.5 Implications for practice

Findings from the studies presented have implications for practice in terms of:

1. Better recognition of the complexity of ARFA patients at clinical presentation enabling referral on to appropriate specialist alcohol care;
2. It may be possible to identify ARFAs at an earlier stage, when they may be more amenable to treatment and more options for targeting preventive treatments are available, resulting in improved health outcomes and cost savings; and
3. It may be possible to predict some outcomes for ARFAs, targeting treatment more efficiently.
4. Whether current policies address the needs of ARFA patients.

Each of these are discussed in more detail in the following sections.

9.5.1 Better recognition of the complexity of ARFA patients and referral to specialist treatment

One major finding was the high level of complexity of ARFA patients. They have more physical and mental health problems and are more socioeconomically disadvantaged than other patient groups. Consequently, and again demonstrated by the data, they have poorer health outcomes. In addition, a wholly attributable alcohol diagnosis does not have to be their main presenting problem, in fact they are more likely to present with a physical ill-health diagnosis which, when coupled with a history of alcohol use, could indicate an ARFA patient.

A national survey of assertive outreach services for ARFAs (Fincham-Campbell, 2018) found 76 services across England offering assertive outreach treatment for ARFAs between December 2015 and June 2016. The majority included a multi-disciplinary team and offered extended support including advice on housing, mental and physical health in addition to alcohol treatment. A randomised controlled trial of assertive outreach treatment for people who frequently attend hospital is currently underway (NIHR, 2016). Public Health England have recently set out pathways for referral to specialist care from hospital for alcohol-related high-cost high-intensity service users (PHE, 2018a).

9.5.2 Early identification of ARFAs and prevention

At what point should attempts at prevention of alcohol-related frequent admissions or intervention to reduce the number of admissions occur? Using the prevention framework including primordial, primary, secondary or tertiary approaches, in the following section each model is explored in terms of the impact it could potentially have on use of health services (Blackwood and Currie, 2009).

Scenario 1: tertiary prevention- treating ARFA problems in an alternative specialist setting other than hospital

Tertiary prevention, or the application of measures to reduce or eliminate long-term impairments and minimise morbidity caused by existing health problems, is particularly applicable to ARFAs who typically have multiple chronic medical conditions and complex social problems. Specialist measures such as assertive outreach treatment could be described as tertiary prevention. Assertive outreach treatment aims to take a case management approach to alcohol use disorder patients, wherever they are in the community or hospital, actively seeking them out if required, and offers multidisciplinary input to addressing problems holistically and early findings are promising (Drummond et al, 2017; Hughes et al, 2013). If more patients could be treated in the community, would ARFAs no longer be an issue for hospitals in terms of the burden they place on services?

Once referred to an AOT service, ARFA status could potentially attenuate (as number of hospital admissions reduces because treatment is being received elsewhere) though late sequelae of harmful and dependent drinking may not. This may result in a different pattern of health service usage by ARFAs being observed which resembles more of a binomial distribution or “m-shape” on the graph of OBDs versus time rather than the normal distribution or “n-shape” observed in figure 16, chapter 8. The first upstroke of the m-shape would be formed as non-frequent alcohol attenders incur an alcohol-related admission along with other admissions (caused by their increased propensity to experience multiple diseases than non-alcohol related patients). After 3 admissions they would reach ARFA status and this in itself could trigger an intervention that moves care of the ARFA in to the community. As a result, ARFA hospital admissions (and OBDs) would start to fall (the first downstroke of the m-shape curve). However, this would be happening against a backdrop of growing morbidity from prolonged and harmful/dependent drinking, which study 4 demonstrates includes high levels of ARLD, which would result in the community being a less-suitable environment for treatment of ARFA problems, consequently hospital admissions and occupied bed days increasing again (the second upstroke of the m-shape). The continually increasing morbidity levels over time resulting from harmful/dependent drinking would now also be resulting in increasing mortality amongst the ARFA group, as a result, admissions start to fall as the cohort reduces in number and OBDs reduce in tandem (the second downstroke of the m-shape curve).

Scenario 2: secondary prevention- reducing drinking levels for ARFAs and screening for other disease

Secondary prevention employs measures to detect early signs of ill health and implement appropriate treatment and interventions. In the context of ARFAs secondary prevention includes measures to reduce alcohol intake for ARFAs as well as screening ARFAs for other conditions, including infections, respiratory disease and diabetes (Roerecke and Rehm, 2014). Of particular relevance to ARFAs, as highlighted by this study, is the potential opportunity for screening for ARLD amongst ARFAs, as ARFAs have been identified as being at increased risk of developing ARLD both in this study and others (Westwood et al, 2017). Indeed, the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) in 2013 highlighted the need for earlier identification of ARLD patients to receive earlier treatment (NCEPOD, 2013). The likely impact of secondary prevention on the shape of the graph of OBDs against time would be a flattening of the bell curve observed in figure 16, chapter 8. Anyone with a history of alcohol related or multiple admissions would be screened for early signs of ARLD, preventing further admissions and reducing OBDs. Known ARFAs screened for infections, respiratory disease, diabetes and mental health problems would receive earlier interventions, again, preventing future admissions and reducing OBDs.

Secondary prevention would also include universal screening of all hospital inpatients for harmful and hazardous drinking with subsequent offer of brief advice or referral on to specialist care depending on drinking levels. In the UK this is already being implemented (see section 9.5.4 below) (Drummond, 2017a).

<u>Scenario 3: primary (before ARFA) prevention</u>

Primary prevention refers to the prevention of disease through the control of exposure to risk factors. In the case of controlling risk factors for becoming an ARFA, this would mean reducing levels of alcohol intake in the whole population. Strategies for primary prevention can include population-wide strategies as well as targeted, high-risk strategies focusing on population sub-groups. Taxation to reduce alcohol sales (such as setting a floor for the minimum price that a unit of alcohol can be sold for known as “minimum unit pricing”, MUP) is one such approach. Given the association between ARFAs and low socio-economic status, this is likely to have a bigger impact on those who are least able to afford it, who as shown by this study, are also the same people who are most likely to become ARFAs. Screening for alcohol amongst all patients in the community, through GPs and alternative approaches for delivering interventions and brief advice (IBA) are also other options for delivering primary prevention (PHE, 2018). The likely impact of primary prevention on the shape of the graph of OBDs against time would be a flattening of the bell curve observed in figure 1, chapter 8 and less steep upward gradient at the start of the graph, as primary prevention should result in fewer alcohol-related admissions to hospital, as peoples’ alcohol issues are addressed prior to ever reaching hospital.

<u>Scenario 4: primordial prevention</u>

Primordial prevention seeks to prevent development of a risk factor, at a very early stage, even before the activities which encourage the emergence of lifestyles. In the case of primordial prevention of ARFA, since age of first problem drinking is directly linked to dependence (Grant, 1997), this would include preventing of the marketing of alcohol to children and education based programmes around harms of alcohol in schools. The impact of primordial prevention on the shape of the graph of OBDs against time would be a flattening of the bell curve observed in figure 1, chapter 8 and less steep upward gradient at the start of the graph, as primordial prevention should result in fewer alcohol-related admissions to hospital, with fewer problem drinkers in the population.

9.5.3 Predicting outcomes for ARFAs

From a practical point of view, is it important to be able to distinguish one alcohol-related patient from another- in other words, between a potential ARFA versus an ARNFA? Clinically, this is probably not feasible in terms of being able to deal with the immediate presenting problem facing the practitioner in the treatment room. But taking into consideration the findings from chapter 5 which showed that ARFAs are more complex than ARNFAs and other patient groups, then being able to differentiate between a potentially more complex patient than a less complex one is important, in terms of the wider clinical input from across the specialties the patient needs. A clinician would need to take in to account factors such as the presence of a chronic alcohol diagnosis and multiple previous inpatient admissions, relative to a person's younger years, to result in them having a higher suspicion of the patient becoming an ARFA in the future. From a non-clinical point of view, distinction between an ARFA and an ARNFA will have operational and economic consequences from the health service perspective.

9.6 Implications for policy

According to the OECD, fiscal policy is the most cost-effective option for reduction of alcohol consumption, in addition to regulating marketing of alcohol. Fiscal policy can include taxation and minimum unit pricing. The OECD suggested that a combination of alcohol policies may help change social norms around drinking to increase the impact on alcohol-related harm (OECD, 2015). Minimum unit pricing was implemented in Scotland in May 2018 and is predicted to prevent 8000 hospital admissions per year. At the end of 2017 Welsh government introduced the Public Health (Minimum Price for Alcohol) (Wales) Bill. A new alcohol strategy for Ireland includes minimum unit pricing. (Williams et al, 2018). MUP is not part of current policy in England.

Although there is currently no over-arching national strategy for alcohol in England, alcohol-related crime objectives were set in 2016 in the "Modern crime prevention strategy" (Home Office, 2016) and national "Commissioning for quality and innovation scheme" (CQUIN) which are being introduced to mental health trusts and community trusts in 2017/18-2018/19 and acute trusts in 2018/19, to focus on alcohol (NHS England, 2017). Specifically the CQUIN refers to: establishing information systems that enable alcohol interventions to be recorded; train relevant staff to confidently deliver alcohol identification and brief advice; and establish a baseline level of performance for alcohol screening and alcohol brief advice or referral. Trusts are incentivised to deliver the CQUIN: the incentive is 25% of 0.25% (0.0625%) of the actual annual value of the aggregate of all payments made to a provider for services delivered under NHS contract (NHS England, 2018). If trusts are meeting the 50% target by the end of quarter 4, 2018/19 and are improving in the meantime, for percentage of unique adult patients who are screened for drinking risk levels AND whose results are recorded in local data systems they will receive the additional 0.0625% income. A further 25% of 0.25% (0.0625%) is available for meeting the target 80% of unique patients who drink alcohol above low-risk levels to be given brief advice or offered a specialist referral if potentially alcohol dependent (NHS England, 2017).

In 2018 Public Health England (PHE) released guidance on alcohol and drug prevention, treatment and recovery (PHE, 2018). PHE concluded that alcohol screening and brief interventions, together with rolling out of alcohol care teams and alcohol assertive outreach teams will produce cost-effective returns on investment. There are currently no financial incentives associated with activity amongst alcohol assertive outreach teams but in future the CQUIN scheme could include this. Although the alcohol screening and brief advice incentives do include referring dependent drinkers on to teams for specialist input, they do not mandate the use of alcohol assertive outreach teams. Whilst a recent survey revealed there to be 76 assertive outreach treatment services in England (Fincham-Campbell et al, 2018) only 6 of the 37 schemes that were studied in depth were found to be offering full assertive outreach service, meaning that many ARFAs still have no access at all to assertive outreach and some receive a less intense variant of the original model. Unless future commissioning policies are expanded to include treatment services and address tertiary prevention, a substantial proportion of ARFAs will remain stuck in the gap between acute hospital care, mental health and addiction services, and continue to reinforce the “revolving door” paradigm of hospital care, exacerbating the consequent but preventable financial burden.

9.7 Conclusions

These novel studies measuring the scale of alcohol-related frequent hospital admissions in England over a 5-year period and associated burden have identified a typical ARFA as being male, aged approximately 55 years, living in a more deprived area, with multiple physical and mental health comorbidities including a chronic alcohol diagnosis. ARFAs are more complex than other patient groups and alcohol is a key factor in causing inpatient admissions (often the primary diagnosis) rather than being an incidental finding.

ARFAs’ medical history is chronic in nature and 10% of ARFAs are frequently admitted to hospital every year for 5 years. ARFAs have poor health outcomes: with higher prevalence rates of alcohol related liver disease seen amongst the ARFA group, compared to the 3 other patient groups. Kaplan Meier survival curves show ARFAs to have a lower probability of survival at 5 years than the other patient groups and this is without the inclusion of deaths outside the hospital.

Risk factors for being an ARFA (age, gender, income, comorbidities, alcohol admission) are present up to 3 years (and possibly further) ahead of becoming an ARFA indicating that there is scope for preventative interventions. Furthermore, ARFAs are often frequent attenders before any diagnosis of ARLD has been made and as such provide an easily identifiable (though not necessarily easily reachable) group for alcohol-related liver disease prevention activities, given that ARLD will soon take over ischaemic heart disease in terms of years of working lives lost.

Nationally, ARFAs are significant enough in number to place a substantial burden on the NHS: ARFAs had the highest average cost per person over 5 years compared to the three other patient groups (ARNFAs, NAFAs and NANFAs). An average ARFA occupies 10 extra bed days per year compared to a non-alcohol frequent attender and this is because ARFAs have longer lengths of stay compared to other groups.

Prevention strategies for ARFA should be expanded to include tertiary prevention approaches as well as specialist treatment for this highly complex, high-cost, high-need group of patients, to reduce harm from alcohol and alcohol-related hospital admissions.

There is considerable scope for further research to build on the findings of this thesis. Further research to aid the development of clinical decision making models for practitioners could alter the pathway and outcomes for patients, as well as impacting on use of health service resources. Further investigation of outcomes for ARFAs, especially deaths outside of hospital and cause of death would contribute to a greater understanding of the disease processes for ARFAs. Linked to this, more detailed research in to the disease pathway between initial ARFA diagnosis and development of ARLD would provide insight into a hugely important but currently less-well described clinical picture.

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11 Appendices

11.1 Measures of deprivation

Index of multiple deprivation, domains

Seven domains of deprivation are combined to produce the overall Index of Multiple Deprivation, each of which contains a number of component indicators. The criteria for inclusion of these indicators are that they should be 'domain specific' and appropriate for the purpose of measuring major features of that deprivation; up-to-date; capable of being updated on a regular basis; statistically robust; and available for the whole of England at a small area level in a consistent form.

<u>Income Deprivation Domain</u>

The Income Deprivation Domain measures the proportion of the population in an area experiencing deprivation relating to low income. The definition of low income used includes both those people that are out-of-work, and those that are in work but who have low earnings (and who satisfy the respective means tests). A combined count of income deprived individuals per Lower-layer Super Output Area is calculated by summing the following six non-overlapping indicators:

- Adults and children in income-based Jobseeker's Allowance families
- Adults and children in income-based Employment and Support Allowance Families
- Adults and children in Pension Credit (Guarantee) families
- Adults and children in Working Tax Credit and Child Tax Credit families not already counted, that is those who are not in receipt of Income Support, income-based Jobseeker's Allowance, income-based Employment and Support Allowance or Pension Credit (Guarantee) and whose equivalised income (excluding housing benefit) is below 60 per cent of the median before housing costs

- Asylum seekers in England in receipt of subsistence support, accommodation support, or both.

In addition an Income Deprivation Affecting Children Index and an Income Deprivation Affecting Older People Index were created, respectively representing the proportion of children aged 0-15, and people aged 60 and over, living in income deprived households.

Employment Deprivation Domain

The Employment Deprivation Domain measures the proportion of the working age population in an area involuntarily excluded from the labour market. This includes people who would like to work but are unable to do so due to unemployment, sickness or disability, or caring responsibilities. A combined count of employment deprived individuals per Lower-layer Super Output Area is calculated by summing the following five non-overlapping indicators:

- Claimants of Jobseeker's Allowance (both contribution-based and income- based), women aged 18 to 59 and men aged 18 to 64
- Claimants of Employment and Support Allowance, women aged 18 to 59 and men aged 18 to 64
- Claimants of Incapacity Benefit, women aged 18 to 59 and men aged 18 to 64
- Claimants of Severe Disablement Allowance, women aged 18 to 59 and men aged 18 to 64
- Claimants of Carer's Allowance, women aged 18 to 59 and men aged 18 to 64.

Education, Skills and Training Deprivation Domain

The Education, Skills and Training Domain measures the lack of attainment and skills in the local population. The indicators fall into two sub-domains: one relating to children and young people and one relating to adult skills. These two sub- domains are designed to reflect the 'flow' and 'stock' of educational disadvantage within an area respectively. That is, the 'children and young people' sub-domain measures the attainment of qualifications and associated measures ('flow'), while the 'skills' sub-domain measures the lack of qualifications in the resident working age adult population ('stock').

Children and Young People sub-domain

- Key Stage 2 attainment: The average points score of pupils taking reading, writing and mathematics Key Stage 2 exam
- Key Stage 4 attainment: The average capped points score of pupils taking Key Stage 4
- Secondary school absence: The proportion of authorised and unauthorised absences from secondary school
- Staying on in education post 16: The proportion of young people not staying on in school or non-advanced education above age 16
- Entry to higher education: A measure of young people aged under 21 not entering higher education.

Adult Skills sub-domain

The Adult Skills sub-domain is a non-overlapping count of two indicators:

- Adult skills: The proportion of working age adults with no or low qualifications, women aged 25 to 59 and men aged 25 to 64
- English language proficiency: The proportion of working age adults who cannot speak English or cannot speak English well, women aged 25 to 59 and men aged 25 to 64.

Health Deprivation and Disability Domain

The Health Deprivation and Disability Domain measures the risk of premature death and the impairment of quality of life through poor physical or mental health. The domain measures morbidity, disability and premature mortality but not aspects of behaviour or environment that may be predictive of future health deprivation.

- Years of potential life lost: An age and sex standardised measure of premature death
- Comparative illness and disability ratio: An age and sex standardised morbidity/disability ratio
- Acute morbidity: An age and sex standardised rate of emergency admission to hospital
- Mood and anxiety disorders: A composite based on the rate of adults suffering from mood and anxiety disorders, hospital episodes data, suicide mortality data and health benefits data.

Crime Domain

Crime is an important feature of deprivation that has major effects on individuals and communities. The Crime Domain measures the risk of personal and material victimisation at local level.

- Violence – number of reported violent crimes (18 reported crime types) per 1000 at risk population
- Burglary – number of reported burglaries (4 reported crime types) per 1000 at risk population
- Theft – number of reported thefts (5 reported crime types) per 1000 at risk population
- Criminal damage – number of reported crimes (8 reported crime types) per 1000 at risk population.

Barriers to Housing and Services Domain

This domain measures the physical and financial accessibility of housing and key local services. The indicators fall into two sub-domains: ‘geographical barriers’, which relate to the physical proximity of local services, and ‘wider barriers’ which includes issues relating to access to housing such as affordability.

Geographical Barriers sub-domain

- Road distance to a post office
- Road distance to a primary school
- Road distance to a general store or supermarket
- Road distance to a GP surgery.

Wider Barriers sub-domain

- Household overcrowding: The proportion of all households in a Lower-layer Super Output Area which are judged to have insufficient space to meet the household's needs
- Homelessness: Local authority district level rate of acceptances for housing assistance under the homelessness provisions of the 1996 Housing Act, assigned to the constituent Lower-layer Super Output Areas
- Housing affordability: Difficulty of access to owner-occupation or the private rental market, expressed as the inability to afford to enter owner occupation or the private rental market.

Living Environment Deprivation Domain

The Living Environment Deprivation Domain measures the quality of the local environment. The indicators fall into two sub-domains. The 'indoors' living environment measures the quality of housing; while the 'outdoors' living environment contains measures of air quality and road traffic accidents.

Indoors sub-domain

- Houses without central heating: The proportion of houses that do not have central heating
- Housing in poor condition: The proportion of social and private homes that fail to meet the Decent Homes standard.

Outdoors sub-domain

- Air quality: A measure of air quality based on emissions rates for four pollutants
- Road traffic accidents involving injury to pedestrians and cyclists: A measure of road traffic accidents involving injury to pedestrians and cyclists among the resident and workplace population.

11.2 Plots of transformed variables Chapter 4, section 4.3.9 and 4.3.10

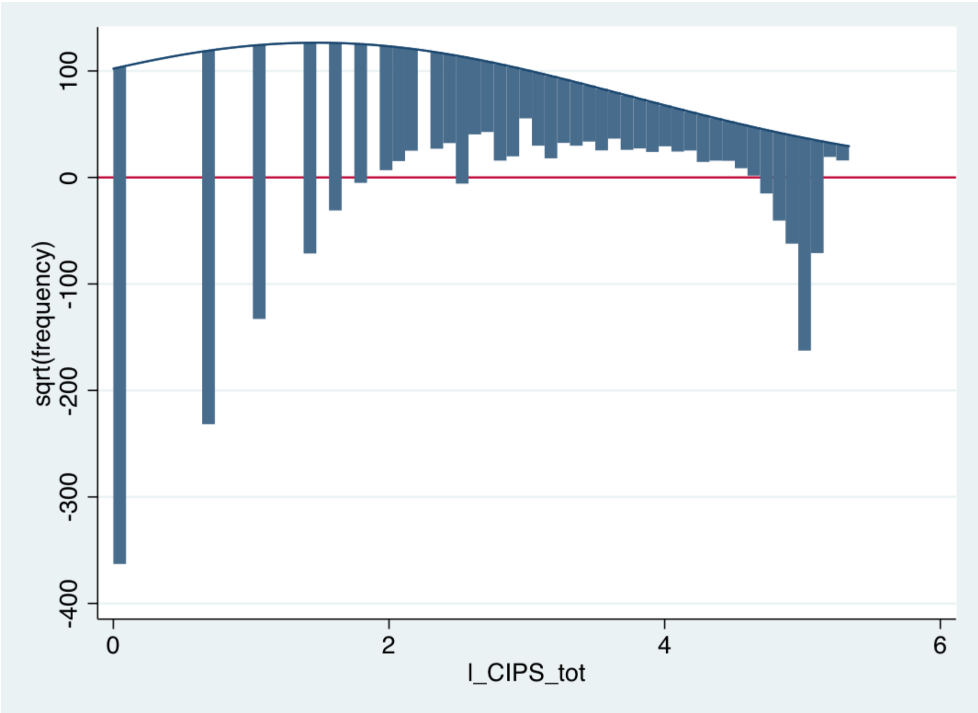

Figure 18: Distribution of transformed variable for total admissions (l_CIPS_tot)

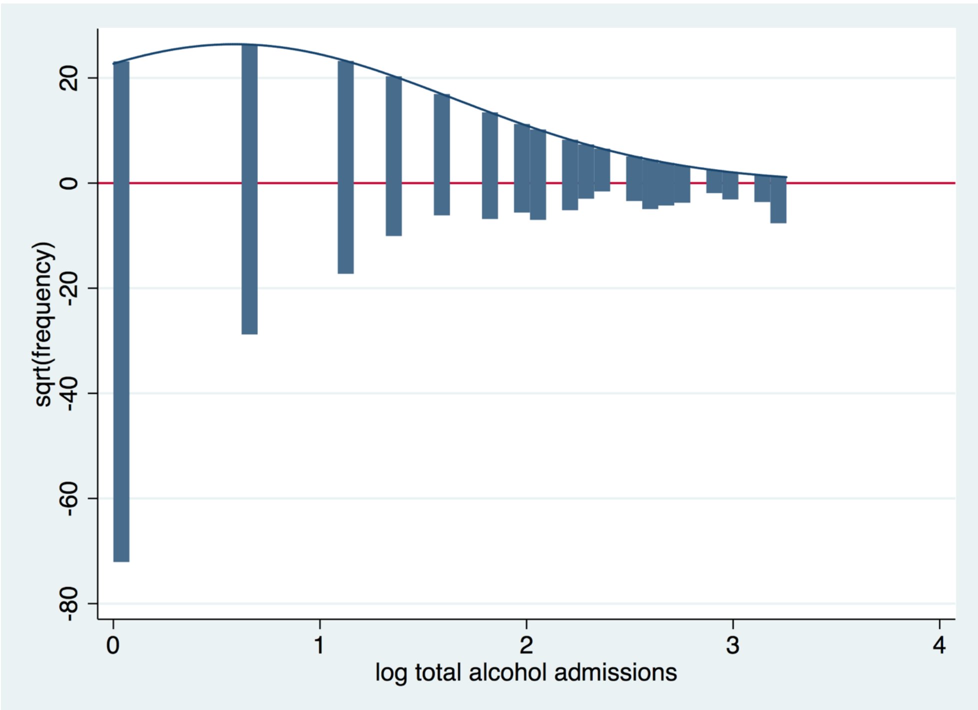

Figure 19: Plot of distribution of log of total alcohol admissions